

WHY THE U.S. AND BRITAIN TANGLED OVER A JET

# AIR & SPACE

Smithsonian

SEPTEMBER 2003

## CLASSICS ON TOUR!

Will they visit your town?

See p.24

1931 Stinson Tri-motor

CAN HONG KONG'S  
AERO CLUB SURVIVE?





Photo Courtesy of Burton "Bud" C. Cook Family



# A floor lamp that spreads sunshine all over a room

The Balanced Spectrum™ Floor Lamp brings many of the benefits of natural daylight indoors for glare-free lighting that's perfect for a variety of indoor activities.

**E**ver since the first human went into a dark cave and built a fire, people have realized the importance of proper indoor lighting. Unfortunately, since Edison invented the light bulb, lighting technology has remained relatively prehistoric. Modern light fixtures do little to combat many symptoms of improper lighting, such as eye strain, dryness or burning. As more and more of us spend longer hours in front of a computer monitor, the results are compounded. And the effects of indoor lighting are not necessarily limited to physical well being. Many people believe that the quantity and quality of light can play a part in one's mood and work performance. Now, there's a better way to bring the positive benefits of natural sunlight indoors.

## Use the Balanced Spectrum Floor Lamp...



...for hobbies...



...at work...



...and when you need a source of balanced light for close-up tasks.

to a 150-watt ordinary light bulb. This makes it perfect for activities such as reading, writing, sewing and needlepoint, and especially for aging eyes. For artists, the Balanced Spectrum Floor Lamp can bring

The Balanced Spectrum Floor Lamp will change the way you see and feel about your living or work spaces. Studies show that sunshine can lift your mood and your energy levels, but as we all know the sun, unfortunately, does not always shine. So to bring the benefits of natural daylight indoors, use the floor lamp that simulates the balanced spectrum of daylight. You will see with more comfort and ease as this lamp provides sharp visibility for close tasks and reduces eyestrain.

Its 27-watt compact bulb is the equivalent

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a source of natural light into a studio, and show the true colors of a work. This lamp has a flexible gooseneck design for maximum efficiency and a dual position control switch for 18 and 27 watts of power, with an "Instant On" switch that is flicker-free. The high fidelity electronics, ergonomically correct design, and bulb that lasts five times longer than an ordinary bulb make this product a must-see.

**Try this special manufacturer rebate offer.** The Balanced Spectrum Floor Lamp comes with a one-year manufacturer's limited warranty and a \$20 rebate. Also, it



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Dennis M.  
Richmond, VA

*My old lamp always left my eyes feeling so fatigued. The balanced spectrum lamp floods my home office with a soft, natural light that actually relaxes me. Balancing my checkbook even seems a little easier now.*

Hudson M.  
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HOPING TO BE RESCUED.**

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SURE NO ONE FORGETS HIM.**

Spending three days at sea after being shot down took courage. Mr. Cook's family thought he deserved to be remembered. So they're placing his name on the Wall of Honor—a permanent memorial dedicated to all those who have shared a passion for flight. The Wall will be unveiled at the new National Air and Space Museum Steven F. Udvar-Hazy Center as part of the 100th anniversary of the Wright brothers' first flight.

**If you have a family member or friend you would like to see immortalized on the Wall this holiday season, call 202-633-2606 or visit [www.nasm.si.edu/wallof\\_honor](http://www.nasm.si.edu/wallof_honor).**







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# AIR & SPACE

Smithsonian

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**Cover:**  
Erik Hildebrandt's photograph, shot at the end of a quiet Minnesota day, invites us back to 1931, when the Stinson Tri-motor was the snazziest airplane in the sky.

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**Editorial:** (202) 275-1230

**e-mail:** editors@airspacemag.si.edu

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## Who Was Second?

As we celebrate the centennial of flight this year, the focus will be on the achievements of two brothers from Dayton, Ohio. But we should not forget that during the first 10 years of the last century, other pioneers were hoping to achieve controlled, powered flight. Many observers had held that Alberto Santos-Dumont, a Brazilian then living in France, was the first to fly a powered, heavier-than-air vehicle when he flew his aircraft, *14-bis*, in Paris on October 23, 1906.

The charismatic, diminutive Santos-Dumont was already renowned for balloon and dirigible experiments in France. It wasn't until the Wrights demonstrated their aircraft in France in May 1908 that their claims of making the world's first powered, manned flight on December 17, 1903, were believed, and Santos-Dumont's 1906 flight was moved to second place.

But Santos-Dumont had many things in common with the Wrights, and as early as 1902 he was aware of their work, and vice-versa. Unlike the Wrights, Santos-Dumont stopped developing designs after 1909, when his 20th aircraft project, the *Demoiselle* monoplane, flew successfully. What is less well known about him is that he enabled Cuban-born New Yorker Aida d'Acosta to solo in one of his dirigibles in Paris on July 29, 1903, and become the first woman pilot.

During the 1990s, curators here realized that the National Air and Space Museum collections left the aeronautical achievements of citizens of Mexico, Central America, the Caribbean, and South America largely undocumented. We organized the first Smithsonian exhibition dedicated to the history of

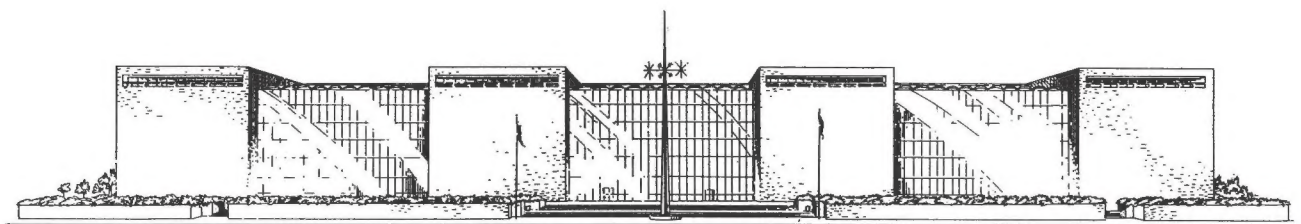
flight in that region: "ARRIBA! The History of Flight in Mexico, Central America, South America and the Caribbean," which opened in September 1998. The panels and small artifacts were surrounded by full-size aircraft that had figured prominently in Latin America. These included a Fairchild FC-2 in Panagra colors, a Douglas DC-3, a Boeing 247, and our Ford Tri-Motor.

The same year, the Museum, in cooperation with the Federal Aviation Administration's National Hispanic Coalition of Federal Aviation Employees, produced a 25-minute educational video entitled "Nuestra Herencia: Building on the Legacy." The film was sparked by a young student who wrote to ask for help learning about Latin American aviation.

Last year, the Latin American Aviation History Collection Plan, which highlights Latin American aviation pioneers, was launched. Our staff is collecting documents, photographs, and historic objects throughout the hemisphere, and the plan also includes provisions to locate at least one major artifact of Latin American provenance to be added to the national collection within the next few years. Our focus is on the pioneering period in the early 20th century, but we'll also look for contributions to aeronautical and aerospace technology that Latin Americans have made since.

These initiatives express the belief that the achievement of manned flight belongs to all humankind. They are an appropriate collection effort for the Smithsonian and the Museum.

—J.R. Dailey is the director of the National Air and Space Museum.





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## LETTERS

### How Real Is the Real Wright Flyer?

I was stunned that two recent articles in *Air & Space/Smithsonian* gave such jarringly different descriptions of the present incarnation of the 1903 Wright Flyer, in terms of its authenticity. "In Search of the Real Wright Flyer" (Dec. 2002/Jan. 2003) asserts that heavy damage, undocumented cannibalization, and the passage of a quarter-century required that Orville Wright indulge in extensive artistic license to prepare the machine for exhibit in England in 1928. Yet "The Original" (Feb./Mar. 2003), by National Air and Space Museum curator Peter Jakab, states that the undisturbed Flyer parts were repaired and reassembled in 1916, and that only relatively minor work was done in 1928 and 1985.

Did the Museum's holding emerge from its lost years as a disassembled airplane awaiting a new fabric covering, or as a box of inchoate, historically corrupt junk? I realize that we are dealing in small details here, perhaps only relevant to reconstructors seeking to replicate the flying qualities of the original machine, but nevertheless, I'm still conflicted over what to think on my next visit to the Museum.

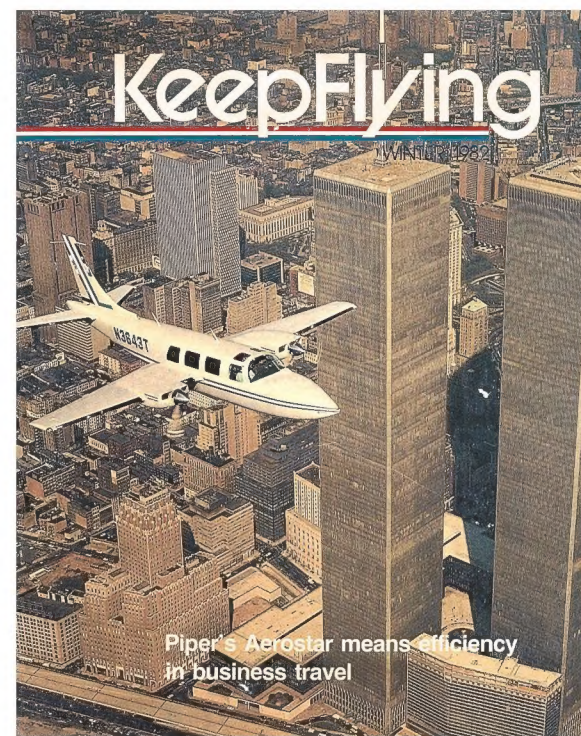
William D. Urban  
Mountain View, California

*Peter Jakab replies: The record on the material history of the 1903 Wright Flyer is fairly clear. Its several restorations are documented in correspondence with the Science Museum in London, the NASM curatorial file on the Flyer, and a 1954 article by Mabel Beck, the Wright brothers' personal secretary, who worked directly with Orville and Wright Company mechanic Jim Jacobs on both the 1916 and 1926-1927 refurbishments of the Flyer. (The full citation of this paper is "The First Airplane—After 1903" by Mabel Beck, U.S. Air Services, December 1954, pp. 9-10. We reprinted it in The Published Writings of Wilbur and Orville Wright, edited by Peter L. Jakab and Rick Young, Smithsonian Institution Press, 2000.)*

*Yes, a number of the engine parts, the propellers, parts of the rudder and canard, some of the wing ribs, a few of the struts, and the fabric have been replaced. But all of this was done by Orville, with Jacobs and Beck. As Wright close friend and confidante Griffith Brewer reported to the Science Museum in September 1927, "Every*

*effort has been made [by Orville] to bring the machine back to the condition when it flew on 17th December 1903." Sure, there are still a few puzzling things, such as the metal strips connecting the front and rear portions of the wing ribs. It's unclear if the ribs were built that way in 1903. But without question, much of what remains did fly at Kitty Hawk, and the repairs and replacement parts were made by the person most qualified to do so: Orville Wright, the original builder of the aircraft.*

*Is the airplane 100 percent original to its 1903 incarnation? No. Is it made up to a significant degree of 1903 material, with replacement parts faithfully representing the original? Yes. I don't see how anyone could argue that the aircraft hanging in the National Air and Space Museum is not the real Wright Flyer.*



### A Second-Anniversary Memory

On May 5, 1981, while employed by Piper Aircraft Marketing, I was assigned to a photo shoot over New York City for the company's new Aerostar 600A. The best photo would be used in a poster for Piper distributors and dealers. As we were flying down the Hudson River, the photographers starting shooting pictures of the New York skyline and captured the airplane flying near the beautiful World Trade Center. The marketing department voted this picture one of the best of the shoot and used it on the cover of the Piper corporate magazine.

Henry W. Putek  
Woolrich, Pennsylvania



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## LETTERS

### Half Cuban, Half Right

Marshall Michel ("Exit Strategy," Apr./May 2003) and one of his sources call the LABS maneuver a "half Cuban eight." However, your diagram shows a maneuver called the Immelmann.

Farron D. Brougher  
Anaheim Hills, California

*Editors' reply: The diagram indeed shows an Immelmann, a maneuver in which the airplane does a half-loop, rolls upright, and flies off. Unfortunately, it did not show the airplane diving back down on the deck to scoot back away from the target. That part is essential to the maneuver the pilots actually flew: a half Cuban eight.*

Marshall Michel quotes me about my experiences flying many LABS missions. He also quotes a "Les Turner" on how popular dental mirrors became to pilots on these missions: "...when a dentist or technician left the room with a pilot in the chair they had to take their mirrors with them or the mirrors would disappear. I still have my dental mirror and no, you cannot borrow it."

"Les Turner" appears to be me too. A similar version of that quote appears in my story "The LABS Maneuver," which is on my Web site, [www.lesfrazier.com](http://www.lesfrazier.com): "...any dentist or technician leaving a treatment room that had a strike pilot in the chair, would take any mirrors away with them. I still have my dental mirror and no, you cannot borrow it."

Colonel Lester G. Frazier  
U.S. Air Force (ret.)  
Georgetown, Texas

### Secrets of the Sabre Fraternity

In "To Snatch a Sabre" (June/July 2003), Ralph Wetterhahn reports that the U.S. pilots had no knowledge that they were fighting Russians. This is not true! I was a pilot with the 335th Squadron, Fourth Fighter Group, which took F-86As to Japan and Korea in the fall of 1950, and I recall being briefed by the CIA as to which Russian units we were engaging and when a new unit was moving into the Antung area. The CIA had radar set up close to Manchuria to communicate to us in the air where the MiGs were and what they were saying on the radio.

Secondly, the radar in the Sperry

APG-30 gunsight was very unreliable. As a consequence, the radar was turned off and the gunsight pegged to compute the correct lead at 1,000 feet.

The MiG could fly higher and climb faster. It could out-turn a Sabre above 20,000 feet. The F-86A could outdive the MiG and turn better below 20,000 feet.

At high speed and under high-G loading, the MiG also had a greater tendency toward high-speed snap rolls. Called Accelerated Overshoot, this was a phenomenon of swept-wing airplanes. Our battle tactics were designed by World War II combat veterans in the Fourth Fighter Group to take advantage of our attributes and minimize our shortcomings. A few MiG pilots were very, very good. Many were rather poor. MiG pilots had difficulty hitting their target, due to slow rate of fire cannon and a poor gunsight.

Richard F. Merian  
Kingston, Tennessee

*Ralph Wetterhahn replies: Regarding the point that "we were briefed by the CIA as to which Russian units we were engaging," my interviews did not turn up any other pilot who was briefed on*



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\*Taurus SEL interior shown with optional leather-trimmed seating and woodgrain package.



## LETTERS

the actual extent of Soviet involvement. I subsequently made another series of queries, and the replies confirmed my first impression. Certainly, the Sabre pilots knew there had to be involvement since the planes were built in the Soviet Union, and there would have to be at least Soviet advisors in the flying units, but the key point that early in the Korean War, all the MiGs were flown by Soviets was fully known only at the highest intelligence levels. The briefing cited by Mr. Merian seems to be an exception.

Secondly, the gunsight radar itself was reliable; its integration with the sight, however, produced problems. About the Sperry gunsight, General "Boots" Blesse maintains, "The earlier gunsights had a pipper in them, and if you didn't have this range limiter to set, the pipper would go off the screen when you turned sharply, and it wouldn't display, because you needed more lead than it could give you. But when they developed [the] range limiter, you'd set it on 1200 feet, for example, and that dot would stay right there.... The range limiter would activate when you crossed 1200 feet. From then on you

were getting actual lead to your target. So you waited for that sign on the circle that was around the dot. When you got that, you were getting good lead."

The Soviets copied the radar mechanism, not the gunsight. My research indicates that the sight was turned off only when it was known to be malfunctioning.

### Hey, That Prop's Going Backwards!

I'm confused by the June/July 2003 cover photo by Chad Slattery: When I flew PT-19s, our propellers spun clockwise (as viewed from the cockpit).

Lt. Col. Phillip M. Goplen  
U.S. Air Force (ret.)  
Zumbrota, Minnesota

Chad Slattery replies: Here's what probably happened. I used a very long shutter speed, and while the shutter was open, I popped a strobe light while a bystander shone a flashlight at the prop. The short-duration strobe defined the prop and gave it sharpness; the ambient flashlight helped capture the prop's motion and produced the blur.

Depending on whether the strobe was popped at the beginning or the end of the exposure, the blur would register either before or behind the prop as it rotated.

### Correction

June/July 2003 "Commentary: Is It Worth the Risk?": We deeply regret not providing the author's correct byline: His name is Frederick Hauck.

Write to us at Letters, Air & Space/ Smithsonian, MRC 951, P.O. Box 37012, Washington, DC 20013-7012. Please type or print clearly. You must include your full address and daytime phone number.

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## SOUNDINGS



KONSTANTIN YUDIN (2)

Kazakh herders use rocket parts (above) for a variety of purposes, such as fencing. Goats climb on a payload fairing from a Proton rocket that brought one of the last modules to the Mir space station (left).

# The Trouble With Protons

**D**mitrij Kalmikov stands in front of what looks like the carcass of a giant metal beetle suspended from the railing of a second-floor balcony. It's not a prop from a performance of Kafka—it's the fuel tank of a Proton rocket that crashed to Earth near Kalmikov's home town, Karaghandy, Kazakhstan, four years ago.

The event and the hazardous waste it spread—Proton rockets are powered by the toxic fuel hydrazine, called heptyl by the Russians—inspired Kalmikov and his staff at the city's EcoMuseum to collect "space junk" from the surrounding countryside. It's part of a campaign to raise awareness and dispel myths about rocket launches from Baikonur Cosmodrome, the legendary cold war-era launch site from which cosmonaut Yuri Gagarin first flew into orbit in 1961.

"The Proton accident scared everyone here," says Kalmikov. "In the villages, no one knew what heptyl was, and this created a lot of myths—like the story that all rocket parts are radioactive."

Russian environmental organizations such as the Socio-Ecological Union blame heptyl for a variety of ills. "Once it enters the body, it can destroy practically all vital functions—the circulatory system, the immune system, and the digestive system," says Sergej Krichevsky, coordinator of the union's program on rocket launches. "It can also cause cancer and mutations."

As a result, some Kazakh politicians have called for an end to Baikonur launches. Kalmikov, who first experienced the dark side of the Soviet Union's technological prowess as a young soldier assigned to clean up the 1986 Chernobyl nuclear disaster, isn't holding his breath. "It's not realistic," he says. "After all, every time there is a car accident in the street, people don't stop driving."

The Soviets selected Baikonur during the cold war because of its remote location, far from the watchful eyes of Western intelligence gatherers. Since the breakup of the Soviet Union, the Russian

Federation has rented the site from the newly minted Republic of Kazakhstan. But despite the change of sovereignty, geographic realities remain constant; Baikonur is still a long way from anywhere. Kazakhstan sprawls across an area four times the size of Texas, between the Caspian Sea and China, yet holds less than 17 million people—one reason why rocket parts falling there have yet to kill anyone.

Although two Proton rockets crashed accidentally in Kazakhstan in 1999, debris falling is also a normal part of every Baikonur launch. Protons, now used primarily to launch communications satellites, drop their first stage on the Kazakh steppe, their second in southern Russia, and their third in the Pacific Ocean.

Kalmikov says that after the spent stages hit the ground, up to two tons of toxic fuel enter the soil. No definitive study has been done to determine the overall impact of the Soviet and Russian space programs on the environment.

## RECORDS



BOEING COMMERCIAL AIRPLANES

## Easy, big fella!

**D**uring flight testing last May, a gaily striped Boeing 777-300ER (Extended Range) staggered aloft at California's Edwards Air Force Base to set a record takeoff weight. (The record was previously set by a 777-300 with a takeoff weight of 678,400 pounds in 1997.) The company's latest addition to the 777 family, the 300ER weighs in at 774,600 pounds. Boeing test-flies its airplanes in Iceland for the crosswinds and tailwinds, in South America for the natural ice, and in the Australian outback for the hot weather, but for critical tests, it uses Edwards, because the facility is not very busy with commercial traffic and has long runways. A director at NASA's nearby Dryden Flight Research Center watching the 777 flight testing noted: "That jet's so big it ought to have its own zip code."



"Right now, our people don't ask the government these things," Kalmikov says. "We want to wake people up."

In addition to the Proton fuel tank, Kalmikov and his staff have collected hundreds of smaller fragments during expeditions on the steppe. There, they met Kazakh herdsman who don't believe the rumors about the rocket parts' radioactivity and are unaware of their toxicity. They use the massive stages, some still plastered with the insignias of Baikonur's U.S. clients, such as Globalstar, as animal pens, kitchens, and car garages.

—Alfred Kueppers

## Over Easy

The first national Team America model rocket challenge, held in The Plains, Virginia, last May, was characterized by high hopes and low comedy. Sponsored by the Aerospace Industries Association and the National Association of Rocketry, the mass launch drew teams from 101 qualifying U.S. high schools to what one AIA official dubbed "Great Meadows Space Port."

The stringent requirements of the contest, which included launching a rocket to 1,500 feet and recovering the payload—two raw eggs—unbroken, were further complicated by wind, rain, and a tornado warning. The lesson that one San Jose, California team member took away from the event was "Wear rubber boots." Observers cried "Heads up!" as cardboard rockets rained down in stages, many of which freefell to the ground.

The essential stage with the payload and an altimeter to measure the flight's altitude had to be brought to the Results Table for validation. "This is a tough engineering problem," said Jay Woodford, who claimed the title of Assistant Results Guy. "If you get the speed up, it helps the stability, but your rocket has to be slow enough not to go too high. Two thousand feet would have been an easier problem."

One team was almost disqualified by range safety officer and astronaut Jay Apt because its members continued, after several warnings, to walk across the middle of the range, where the cables from launch control officer Jennifer Ash-Poole's ignition button ran to the launch stands. (Apt

had similar problems with many of the adults attending the event.)

Small-town Boonsboro, Maryland, took top prize. But undoubtedly a consolation prize should have gone to team number 1540 from Chicago, which was immediately disqualified when the leader, while unpacking, dropped and broke an egg on the results table. Estimating height by eyeball alone, team member Josh Saltzman nailed—within 50 feet—the altitude his rocket achieved. "We won't place, but at least it worked, which is a good thing," he said. A positive outlook is good thing in a future rocket scientist.

—Linda D. Voss

this tragedy as opposed to just figuring out what happened and then locking the debris away," says Michael Leinbach, the shuttle launch director at NASA's Kennedy Space Center in Florida, who has overseen the handling of *Columbia's* remains while investigators piece together the story of its demise. Leinbach found support for his idea throughout NASA and among the *Columbia* crew's families.

All seven members of the shuttle's crew were killed on February 1, 2003, when *Columbia* broke apart as it reentered Earth's atmosphere. Teams of federal, state, and local emergency response and safety personnel, as well as thousands of

## NEIGHBORHOOD WATCH



NASA/JPL/MAIN SPACE SCIENCE SYSTEMS

## Mars Makes a Close Call

On August 27, Mars will be closer to the Earth than it has been in 60,000 years," says California's Jet Propulsion Laboratory scientist Myles Standish, who is related to the Pilgrim colonist of the same name, though he's not sure exactly how. "Last time that happened was on September 12, 57,617 B.C."

Standish is in charge of plotting planetary positions for NASA's deep-space probes, astronomers, and even the occasional astrologer. He makes his plots using gravity models, Einsteinian physics, and measurements from massive radar dishes and spacecraft. "It takes a while to compute all this," says Standish. "Of course, if I didn't have a computer, just a calculator, it would take me anywhere from a year to a lifetime just to figure this one out."

The next time Mars will be this close to Earth is August 28, 2287. "I'll probably go outside and check out Mars this August," he says. "But I don't think I'll care in 2287."

## Columbia's Last Mission

Of all the space shuttles, it was *Columbia* that most often was tapped for science missions, so it is a fitting legacy that its remains will not be buried, like those of *Challenger*, but preserved as a laboratory for researchers working on new spacecraft, more advanced materials, and improved crew equipment.

"I just thought we owed it to the astronauts and their families to learn from

volunteers, spent the next three months picking up the pieces, eventually recovering about 39 percent of the shuttle (by weight). More than 83,000 items were trucked to an ad hoc forensics lab in a hangar at Kennedy.

Debris from the 1986 *Challenger* accident had been buried in a missile silo at Cape Canaveral Air Force Station, adjacent to Kennedy Space Center. "I talked to the guy who put *Challenger* in the silo and he said, 'You know Mike, it'd be a whole lot easier if you just put



Rain didn't deter determined rocketeers.

LINDA VOSS



## UPDATE

## U.S. Air Force Museum Centennial of Flight

World War I Dawn  
Patrol Rendezvous  
Wright Field  
Wright-Patterson Air  
Force Base  
Dayton, Ohio  
Sept. 12–14, 2003  
Phone (937) 255-8046, ext. 492  
Web site: <http://www.asc.wpafb.af.mil/museum>

Vintage aircraft—Nieuports, Fokker Triplanes, Royal Aircraft Factory SE.5s, Sopwiths, Bristol fighters—perform along with World War I reenactors in an encampment, radio-controlled World War I model aircraft, and period autos, all accompanied by the era's music. There will also be a swap-and-shop for collectibles. Bring blankets or lawn chairs, and expect crowds: typical attendance is 20,000.



JAMES DIETZ/FRED JUNGCLAUS

*Columbia* in the same silo with *Challenger*,” says Leinbach. “I told him, ‘You’re probably right—it’d be a hell of a lot easier. But we’re not going to do it.’”

The criteria for lending the debris to researchers is still under development and for now will be decided on a case-by-case basis. Particular scrutiny will be given to requests for items considered sensitive by the crew's families. For example, part of one of

*Columbia*'s broken crew seats may be made available relatively quickly to structural engineers working on NASA's next manned space transport system, but a request for a piece of an astronaut's spacesuit will set off a much more rigorous review—“and I'm not saying that we ever will be able to give that out,” Leinbach adds.

Also still undetermined: if any of the shuttle debris might be made available for museum or other public viewing. “It's under consideration,” Leinbach says.

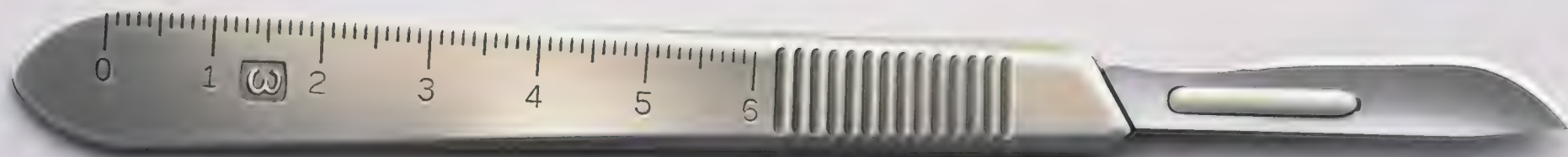
—Irene Brown

## Future Fixes

Throughout the investigation of the loss of the shuttle *Columbia*, the question of why the astronauts had so little ability to inspect and repair the exterior of their spacecraft became a focus of many discussions. Immediately after the February 1 disaster, NASA engineers began examining what repairs might be possible while a shuttle is orbiting.

The Johnson Space Center collected dozens of innovative schemes involving access platforms, extendable booms, quick-curing “goop guns” and sculptable replacement tiles, and “arm wrestling” maneuvers between the shuttle and the space station to create an orbital dry-dock. The primary goal for inspections would be to determine how detailed a view is required to detect serious damage. Some surface areas can be surveyed to a resolution of several inches, while other areas would need resolution of a half an inch.

For repair capabilities, NASA concentrated on what it called “critical and reasonable damage.” Some proposed solutions had been around for a quarter of a century, from before the *Columbia*'s



## Prostatectomy

- Months of recovery
- Probable impotence
- Higher risk of incontinence



first flights in 1981. "Tile repair concepts from [that time] focused on silicone material squirted into a void with a device similar to a caulking gun," says Bill West, a NASA spokesman and former developer of space-walk tools.

Since the tiles are glued to a metal substrate, they are not very susceptible to major damage. This isn't true for the reinforced carbon-carbon material on the wing leading edge panels, since the 1/3-inch-thick composite is free-standing and anchored only by bolts along its periphery. Airgun tests showed that falling foam can fracture the material or break its fasteners and cause adjacent sections to shift, opening up gaps.

Repair of such damage is more of a challenge. Astronauts first have to reach the damaged areas. Using a jet backpack with adequate fuel (the current system, Simplified Aid for EVA Rescue, is for emergencies only), an astronaut could reach any part of the shuttle—but NASA is cautious of the risks of this approach.

Another suggestion was to install a 60-foot boom along the right edge of the shuttle's payload bay, in much the same arrangement as the robot arm installed along the left edge. The arm would grab the end of the boom and its retaining latches would be opened, allowing the arm to maneuver the boom's other end to any point on the underside of the

## UPDATE

### Western Reserve Historical Society

Cleveland, Ohio  
Phone (216) 721-5722, ext. 228

On October 8, 2003, the Crawford Auto-Aviation Museum of the Western Reserve Historical Society will bring its replica of the Wright brothers' 1902 glider to Kitty Hawk, North Carolina, to again re-create the Wrights' test flights. Last year at the dunes, the replica made more than 100 flights, with the longest over 300 feet—a full 30 seconds. The Western Reserve Historical Society invites you to volunteer as a member of the ground crews that launch the glider. Contact Edward Jay Pershey, WRHS director of education and research, at the phone number above, or e-mail [pershey@wrhs.org](mailto:pershey@wrhs.org).



SCOTT CARPENTER/WRHS

shuttle. This option, according to a NASA report, has "the lowest overall operational complexity [and] risk", and provides access when the shuttle is not docked with the space station.

The use of the space station is the only one that "is an existing capability," NASA's report notes. The shuttle's robot arm would grapple the station and then turn the shuttle's belly toward the station. The station's arm would then carry the astronaut and repair tools to the damaged area.

NASA's task force was to have hardware ready to fly by the beginning of next year. When the next shuttle rockets into orbit to resupply the space station, it may carry an additional crewmember or two who will perform test tile repair on spacewalks. The technology of tile inspection and repair, NASA workers expect, will be ready. To fix broken panels—the flaw that destroyed *Columbia*—could take several months.

—James Oberg

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1. Blasko JC, Grimm PD, Sylvester JE, Badiozamani KR, Hoak D, Cavanaugh W, "Palladium-103 Brachytherapy for Prostate Carcinoma," *Int J Radiat Oncol Biol Phys*, March 2000, 46(4), 839-850.

2. Potosky AL, Legler J, Albertsen PC, Stanford JL, Gilliland FD, Hamilton AS, et al. Health Outcomes After Radical Prostatectomy or Radiotherapy for Clinically Localized Prostate Cancer: Results from the Prostate Cancer Outcomes Study (PCOS). *J Natl Cancer Inst* 2000; 92:1582-1592.

3. The most commonly reported side effects of prostate brachytherapy are short-term urinary or obstructive symptoms within the first few weeks after the implant procedure.



# To the Moon—On the Cheap

**D**riving into Alexandria, Virginia, you will pass a simple brick building on Wythe and North Fayette Streets. From the road, it looks like it could be a warehouse or maybe a repair shop. In February of 1994, I was invited to take a look inside. A thick barbed wire fence and a heavy steel door were my first clues that the building had a more important purpose. Once inside I found myself in a restricted-access control center filled with sophisticated computer equipment and dozens of display consoles. Plainclothes technicians, who looked at me suspiciously as I walked past, spoke to one another in acronyms. As I ventured further, my unease suddenly turned into excitement. In front of me was a large monitor displaying live images from a spacecraft called Clementine. As a planetary geologist at the Smithsonian Institution's Center for Earth and Planetary Studies, I had been invited here to witness history. For the first time since the Apollo era, the United States had placed a craft into lunar orbit, and I was watching the craft's data come back to Earth.

Despite the clandestine control center, Clementine was no secret. However, to many, its journey has been.

During the 1960s and '70s, interplanetary spacecraft cost billions of

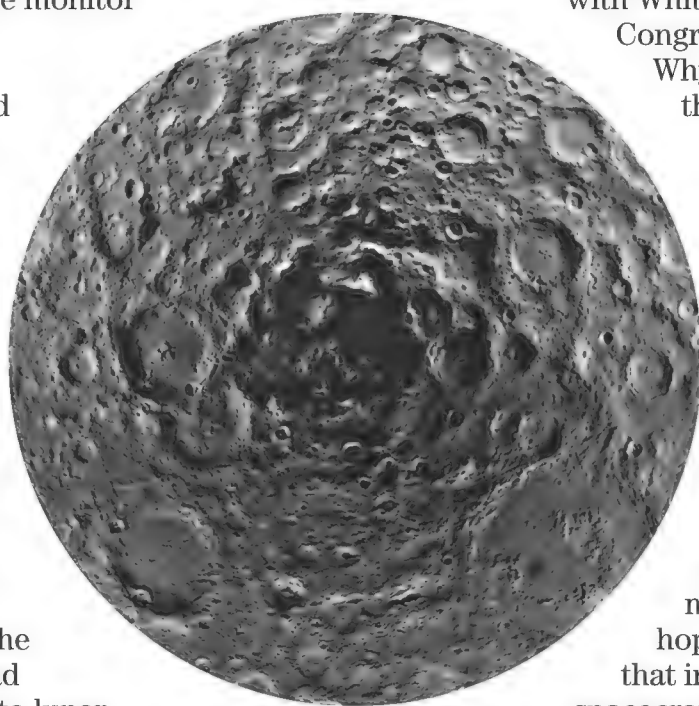
dollars each. Instruments in particular were extremely expensive. By the 1980s NASA began designing spacecraft to be deployed from the space shuttle in an effort to reduce launch costs. Due to the enormous expense of maintaining and launching the shuttle itself, however, the price of some interplanetary missions, such as one planned for Jupiter, actually increased. In contrast, the Department of Defense had made great strides in reducing the costs of space missions by using expendable boosters and off-the-shelf instruments. But how to demonstrate these innovations to the civilian community? The answer emerged in September 1989, when Stu Nozette, a mission director for the

Department of Defense, had drinks with White House and U.S. Congressional staffers.

Why not take some of the instruments being developed for the Strategic Defense Initiative (better known as the "Star Wars" space-based defense plan) and fly them to an asteroid? By allowing NASA scientists to participate in the mission, the military hoped to demonstrate that interplanetary spacecraft could be flown at

lower cost than NASA's past efforts. Nozette proposed calling the mission "Clementine" because, as the old song puts it, the spacecraft would be "lost and gone forever" after exploring the asteroid. Nozette made some rough sketches of Clementine on a napkin and passed it around the table.

By January 1992, Clementine's mission had been expanded to include two months in lunar orbit, where it



*This view of the moon's south pole was composed of 1,500 images taken by the spacecraft Clementine.*



## The Countdown Continues

**T**he National Air and Space Museum's Steven F. Udvar-Hazy Center will open in four months, on December 15, giving visitors the opportunity to see such artifacts as the gondola of the *Pilgrim*, the first airship designed for inflation with helium. Built by the Goodyear Tire and Rubber Company of Akron, Ohio, in 1925, the *Pilgrim's* frame was made of magnesium-coated steel tubing, and its envelope was a two-ply, rubberized, aluminum-coated fabric. The tiny gondola held one pilot and two passengers. After making 4,765 flights to train airship pilots and demonstrate lighter-than-air technology, the *Pilgrim* retired in 1931; two years later the gondola became part of the Smithsonian's collection.

would map the surface of the moon before going on to explore an asteroid. The Department of Defense chose the Naval Research Laboratory in Washington, D.C., to carry out the mission. NRL selected a suite of instruments from the Lawrence Livermore National Laboratory, outside San Francisco, including several cameras and a laser-ranging system capable of measuring the height of objects on the moon. NASA provided tracking support through its worldwide Deep Space Network of antennas as well as a team of scientists to maximize data return. In March, NRL and Livermore received final approval and funding from the Department of Defense, along with orders to fly Clementine within 22 months at a cost of no more than \$200 million.

No one had ever built an interplanetary spacecraft in such a short time and with so little money. Many people thought the project would fail.

The team immediately constructed an engineering model of Clementine, which was used to test the stresses of launch and the effects of the space environment without damaging the actual spacecraft. Clementine quickly came together. Late one night, as tests were being



*The Steven F. Udvar-Hazy Center's hangar features an elevated walkway for viewing hanging aircraft, including the Pennzoil Special (unwrapped), a de Havilland-Canada DHC-1A Chipmunk once owned by aerobatic and movie pilot Art Scholl, who flew the monoplane at airshows in the 1970s and '80s.*



CAROLYN RUSSO

completed, NRL engineers ordered take-out from a Chinese restaurant. One of the fortune cookies read, "You will soon take a very pleasant and successful trip." The engineers taped the fortune to Clementine.

On January 24, 1994, Clementine was launched from Vandenberg Air Force Base in California, on schedule and within budget. Clementine went into lunar orbit on February 19, and by May 3, it had collected almost two million digital images of the moon—more images than had been gathered by all previous planet-exploring spacecraft combined. Scientifically, Clementine picked up where the Apollo missions had left off, yielding such images as a giant impact basin on the far side of the moon and a portion of south pole terrain that had previously been imaged poorly. Filters on Clementine's cameras also allowed scientists to map the distribution of minerals on the lunar surface. And the laser-ranging system provided the first topographic map of the entire moon, which revealed previously unknown mountain ranges. Unfortunately, a software error caused all of the propellant for the spacecraft's attitude control system to be lost before Clementine could fly on to an asteroid.

Several years later I ran into Stu Nozette at a science conference. He mentioned that the NRL still had the engineering model used to test Clementine's capabilities. Would the Smithsonian be interested in acquiring it? I immediately said yes. Stu went to work, and soon engineers at NRL were outfitting the model with parts identical to those flown on the actual spacecraft. The Lawrence Livermore National Laboratory generously donated costly flight spares of many of the instruments, even though the facility could have used them on other craft.

Recently, I had the honor of signing the delivery slip for the first spacecraft to demonstrate that civilian space missions could be flown without spending a fortune. The Clementine engineering model now hangs in the National Air and Space Museum's Lunar Exploration gallery, while the Clementine launched in 1994 is presently orbiting the sun, along with other spent space probes. Although now lost and gone forever, it was a darlin' of a spacecraft.

—Bob Craddock is currently serving as scientific advisor to the Smithsonian Institution's under secretary for science.

## VISITOR INFORMATION

**Hours** The National Air and Space Museum is open 10 a.m. to 5:30 p.m. seven days a week. General admission is free.

**Location** The Museum is located on the National Mall at 7th Street and Independence Avenue SW, Washington, D.C., west of the U.S. Capitol. The closest Metro station is L'Enfant Plaza.

**Food** The Wright Place Restaurant offers breakfast and lunch fare from McDonald's, Boston Market, and Donatos Pizzeria. 10 a.m. to 5 p.m.

**Tours** Free docent-led tours explore the Museum's collection and trace the history of air and space travel. Tours are given daily and depart from the Tour Desk, South Lobby.

**Lockheed Martin IMAX Theater** Experience the thrill of films produced in IMAX and projected onto a screen seven stories wide and five stories high. Feature films include *To Fly!* and *Space Station 3D*, which documents life and work aboard the International Space Station. For more information, call (202) 357-1886 or (202) 357-2700.

**Albert Einstein Planetarium** Embark on a celestial adventure. Realistic astronomical experiences are produced under the planetarium's 70-foot dome. The current feature, "Infinity Express: A 20-Minute Tour of the Universe," zooms audiences through the solar system, past the Milky Way, and out to the very edges of the cosmos. For information, call (202) 357-1686.

**Events** The Museum offers the public a variety of programs, including lectures, concerts, temporary exhibitions, and educational workshops. To receive the latest calendar of events by mail, write to: Calendar, National Air and Space Museum, Room 3733, Smithsonian Institution, Washington, DC 20560-0321.

*Except where noted, no tickets or reservations are required. To find out more, visit [www.nasm.edu](http://www.nasm.edu) or call the Smithsonian Information line at (202) 357-2700; TTY (202) 357-1729.*



# Going Topless

**M**y long-standing love affair with the North American F-100 Super Sabre started in 1957 at Nellis Air Force Base in Nevada, where, as a second lieutenant, I learned to fly the A and C models. The early models were pretty basic: moveable leading edge slats, a 45-degree swept wing, no flaps, and a big Pratt & Whitney J57 engine that made the Super Sabre the fastest airplane in the world at the time. With its four 20-mm cannon, it was a great fighting machine—just the thing for a newly minted fighter pilot. There's a photo in my scrapbook captioned "Have cannons—will really travel," a reference to the business card of a TV gunfighter named Paladin. With my chaps-like G-suit, helmet, oxygen mask, and 20-mm cannon, I felt like a high-flying Paladin myself.

A lot of air flowed under my wings in a variety of aircraft and in some ho-hum assignments until the 1970s, when my Air National Guard unit at Mansfield, Ohio, finally got the D and F model Super Sabres. I was also a flying instructor for the unit and got to fly both models almost daily. One job that was not so much fun was riding in the back of an F-100F two-seat trainer while checking out a new pilot in the front seat.

Mission number three for each new jock was a flight to a restricted area for his first straight-and-level supersonic flight. One of my students had previously flown de Havilland Caribous in Vietnam. Despite his lack of tactical jet experience, Dick was a great student and took to flying jet fighters like a champ. He followed the checklist religiously—we even breathed 100 percent oxygen from engine start to shutdown. Little did we know that driving the nitrogen out of our blood was about to save us from a severe case of the bends.

Our supersonic-flight area was a 5,500-square-mile sparsely populated region in southwest Ohio. We entered at the west end at 29,000 feet and got ready to go supersonic. Dick had just commented that the cabin altitude, 12,500 feet, was ideal.

The medical report makes for pretty

dry reading compared to what we experienced during the next few minutes:

*At 1525 hours, 27 Oct. 73, flying at 29,000 feet, the canopy locking mechanism failed on the aircraft (F-100) that Maj. Vogel was flying. When mechanism failed, the canopy separated from the aircraft, causing an explosive decompression. Maj. Vogel was in the back seat, resulting in his being severely and violently thrown around the cockpit of the aircraft.*

It was like sitting in the center of an explosion. At 29,000 feet, the gases in my body expanded to five times the volume they would have had at sea level. Air was rushing out of my mouth and nose, but my chest and abdomen swelled to three to five inches more than their normal size. (My wife is not the only member of the family with stretch marks.) My head bobbed around uncontrollably and my arms flailed outside the aircraft. I estimated that we were doing about 550 mph. I could not control my arms or my head. The helmet visors rapidly fogged up and cleared again and again.

Even though I had the seat belt and shoulder harness fastened tightly, several times my upper body was almost thrown out of the cockpit. The aircraft slewed from one side to the other, and in one case my upper body was extended so far out I could see the entire side of the airplane. I remember seeing the six-foot stainless steel pitot boom on the aircraft's nose bent like an archer's bow. Normally we could stand on it without it giving at all, yet the air loads curled it over as easily as if it were a sapling.

The back-seater had a solid metal plate windscreen that automatically deployed if the ejection sequence was initiated. Since the canopy tore off the airplane, the windscreen had to be deployed manually. Air loads on my body were so great that I was pinned to the seat. Fortunately, Dick

*The author and his student were victims of an explosive decompression when the canopy on their F-100 blew off.*



HARRY WHITVER



was behind the front windshield and knew his emergency procedure. He immediately chopped the power, deployed the speed brake, and started a climb to slow the aircraft to below 250 mph. At that speed, I could reach forward and deploy the screen. That started an altogether different airflow pattern, which lent some humor to the situation. As we started a painfully slow descent to Wright-Patterson Air Force

making a second trip around the stick. Since I didn't want to lose it, I stuck my left hand up and caught it just as it was flying out of the cockpit. Dumb! I could have broken my hand. This time, I tucked the hat under my left leg.

The temperature at 29,000 feet is about 50 degrees below zero, and at 550 mph the wind chill was off the scale. I guess my blood was racing so fast I didn't feel the cold until we were

lungs. The rescue crews went back to their quarters, so a friendly maintenance supervisor took us to the hospital in his truck. The flight surgeon was not on duty, so we didn't get the observation we should have. After taking blood samples and listening to our hearts, another doctor sent us to a motel and cautioned us to watch each other for "bad signs." We were nauseous and lightheaded, and while coming down from our euphoria and adrenaline high, our fuzzy minds couldn't identify "bad signs." Without instructions to report back, we simply drove home the next day.

I've flown only two open-cockpit aircraft in my long career. The first was a Waco UPF-7. The second was the topless F-100. The flight ended safely, but I still suffer side effects. My abdominal muscles and tissues were so damaged that last year I had three hernia surgeries within eight months.

As for Dick, one year later he sat up in bed, fell back, and died when his aorta tore away from his heart. My surgeon said that I might have been half a heartbeat away from the same fate. When we explosively decompressed, his heart may have been in the systolic phase—in contraction—and mine in the diastolic—the phase between beats.

—Joseph L. Vogel

**It was like sitting in the center of an explosion. At 29,000 feet, the gases in my body expanded to five times that at sea level. Air was rushing out of my mouth and nose, but my chest and abdomen swelled to three to five inches more than their normal size. (My wife is not the only member of the family with stretch marks.)**

Base in Ohio, I saw the aeronautical charts jiggle out of the case by my right leg, make two lazy circles around the control stick, and exit over my left shoulder. Maybe it was oxygen deprivation, but at the time it sure seemed funny to me.

I had a special fuzzy warm hat that I kept under my right thigh when I put on the helmet. After a sweaty flight, I'd take off my helmet and put on the hat to ward off the Ohio cold. I suddenly saw the hat

descending. Another vivid recollection was that the buffeting in the back of the F-100F became severe if we allowed the airspeed to rise above 250 mph. It took us an eternity to get on the runway, and the sight of the rescue vehicles from an open-cockpit jet fighter was really odd.

After an explosive decompression, regulations call for overnight observation in a hospital. We could have died if nitrogen bubbles formed in our chest, restricting blood flow to the heart and

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# When Cessnas Wore Rotors

**T**he name Cessna evokes images of single- and twin-engine airplanes and business jets—never helicopters. But Cessna built several dozen helicopters, one of which has held a world aviation record for 45 years.

In 1951, Cessna president Dwane Wallace coveted a share of the burgeoning helicopter market, but the company lacked rotary-wing expertise. Meanwhile, Charles M. Seibel had patented the simple, robust Seibel Control System, which used a simpler mechanism than contemporary designs, and the cash-strapped Seibel Helicopter Company, with only four employees, had just built and certified its S-4A helicopter on a meager \$125,000 budget.

Wallace arranged a merger in March 1952 and appointed Seibel chief engineer of the new Cessna Helicopter Division, with the design goal of superior high-altitude performance without sacrificing speed. Seibel married his control system to a 260-horsepower supercharged Continental FSO-470 engine mounted in the nose (with a cowl that slid forward for easy maintenance), routed the enclosed main rotor shaft vertically through the cabin, installed the battery and generator in the tail boom to offset the engine weight forward, and christened the result Cessna Helicopter #1 (CH-1). The prototype flew in 1954 and received certification a year later.

In September 1955, the CH-1, flying in the Colorado mountains, established several helicopter firsts: a flight from mile-high Fort Carson to 10,000-foot Camp Hale, a four-soldier payload flown into and out of Camp Hale, takeoffs and landings at 14,000 feet, and a landing on Pike's Peak with three people on board. The following year, the Army ordered 10 (as YH-41 Senecas).

Cessna next challenged the helicopter altitude record. On December 29, 1957, Army Captain James E. Bowman flew a specially modified (and stripped) CH-1B to two U.S. records, today surpassed only by turbine helicopters: 29,777 feet in the



*Cessna had a brief fling with rotary-wing flight with its CH-1 helicopter.*

1,102–2,204-pound class, and 28,090 feet in the 2,204–3,858-pound class.

The Army Aviation Board's 1958 report faulted the YH-41's 200-mile range and the need to fly without cockpit doors when outside temperatures exceeded 70 degrees Fahrenheit (otherwise, cockpit ventilating air, heated in the engine compartment manifold, made the cockpit unbearable), but it praised the craft as superior to standard light observation helicopters for missions at high-density altitudes. The report recommended against additional procurement until Cessna corrected some squawks, such as the aircraft's tendency to drop off to the left when power was abruptly reduced, difficulty in maintaining heading and airspeed in turbulence, and a decrease in stability when a rear-seat passenger so much as moved. "With our fixation on performance, we had neglected handling qualities," Seibel admitted, and set out to correct the problems.

Cessna test pilot Jerry Pohlen demonstrated the improvement in stability by putting the aircraft in a hover, climbing into the rear seat—and sitting there for four minutes. The Army responded that "Cessna personnel demonstrated fixes for every major problem.... This progress is commendable compared to past experience with other contractors."

In 1959, the Experimental Test Pilots Association awarded Air Force Major Robert G. Ferry the Ivan Kincheloe Outstanding Test Pilot of the Year Award

for the rescue of an injured civilian near Mount Whitney in California. Ferry and two crewmen flew a YH-41 from California's Edwards Air Force Base, located the victim at 9,300 feet on a 30-degree sloped clearing flanked by 100-foot trees, retrieved him, and ascended vertically with four on board. Ferry claimed that no other helicopter could have completed the mission. The following year, the civilian CH-1C Skyhook became the first helicopter certified for flight in instrument conditions. And during the 1962 Seattle World's Fair, Seattle Helicopter Airways CH-1Cs carried 10,000 sightseers.

But failures and accidents, including at least four fatalities, plagued the civilian aircraft. In 1963 Cessna discontinued civilian production and bought back all commercial CH-1s to avoid future product liability. According to an internal memo, Cessna management wanted "to wipe the word helicopter from the Cessna vocabulary," a goal which seems to have been achieved.

All told, Cessna produced only 44 helicopters, including, under the U.S. Military Assistance Program, six for Ecuador and five for Iran. The Army and Air Force continued to fly YH-41s for several years to test helicopter performance at high-density altitudes. The last known YH-41 ended up in the Army Aviation Museum at Fort Rucker, Alabama.

—Walt Shiel

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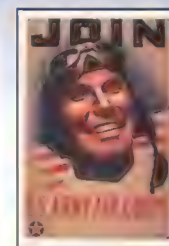
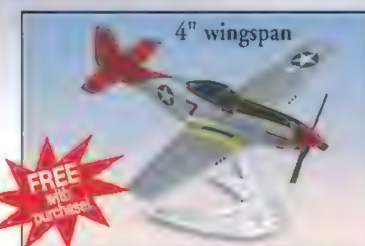
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# THE MAGICAL HIS

Greg Herrick, a collector of airplanes from the period between the two world wars, has a story to tell. He puts his beer down, raises his hands like paws, and growls like the junkyard dog he found guarding an airplane stashed on a ranch in Caldwell, Idaho.

"The dog jumped up against the car door," he says. "There was no way I was getting out of that car. So I tossed him a peanut butter cracker. He sniffed it, then gobbled it up. I got out of the car real slowly and said, 'Sit!' When the dog sat, I gave him some more crackers. I was all set."

After several years of phone calls and casual visits, Herrick had thought this

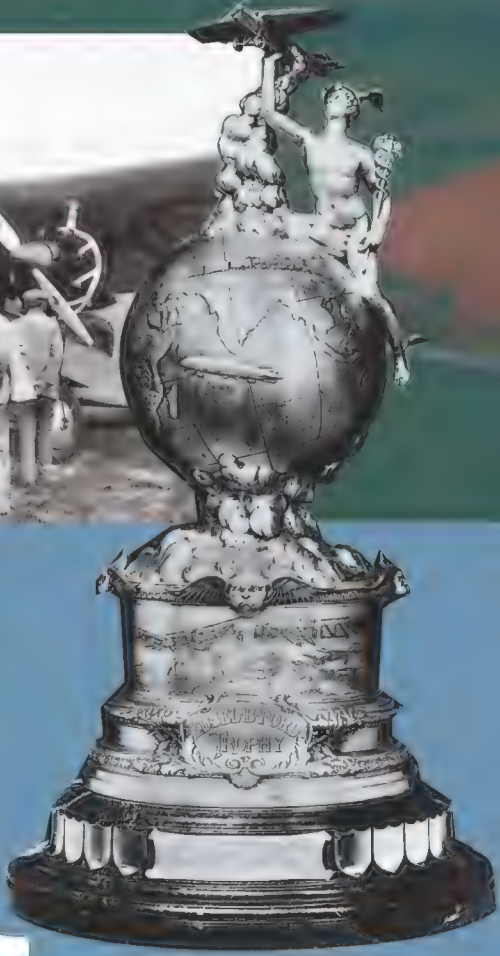
*The sole surviving 1926 Ryan M-1 will visit 26 cities this fall, joining other Golden Age craft in an air tour revival engineered by collector Greg Herrick. The original 1925-1931 tours showcased such aircraft as the Ford Tri-motor 4-AT (inset) and awarded winners the Edsel B. Ford Trophy (right) for reliability.*

ABOVE: GILLES AULIARD





Travel Airs, Ryans, and Tri-motors  
are coming to take you away.



# TORY TOUR

BY MARY COLLINS

INSET: WWW.NATIONALAIRTOUR.ORG.  
LEFT: NASM (SI NFG. #7A40155)



time he might be able to convince the elderly cropduster and ranch owner, Gene Frank, to give up the beat-up jewel lying in the grass behind the wire fence, the “No Trespassing” signs, and the dog: the oldest Ford Tri-motor in existence.

But when Frank pulled up in his truck and saw his guard dog sitting down on the job, he reached for his shotgun.

“That damn dog!” he exclaimed.

“I shouted at him to stop,” Herrick says. “I told him I’d won the dog over with crackers.”

Maybe Frank decided to take the dog’s placid reaction to Herrick as a good sign: After years of trying, Herrick finally got the Tri-motor. The rancher eventually sold him several airplanes, including a 1929 Keystone-Loening Commuter K-84 and a Cunningham-Hall PT-6F. “Even though he thinks of

me as a son, he wept when he sold them to me,” Herrick says.

He understands why Frank was so attached to the airplanes; collectors sometimes see a value in objects others miss. For Herrick, the airplanes represent an era in aviation history of unbounded energy and optimism. In the 1920s and ’30s as many as 180 companies churned out airplanes. But many of the models introduced during that period are gone. The Keystone-Loening K-84, for example, is the last of its type. It is one of the trademark biplane flying boats of Grover Loening, who designed the first short-hulled flying boat while working for the Wright brothers. When Loening opened his own company, he competed for Navy contracts (Leroy Grumman was one of his employees), but also built civil craft. Herrick’s K-84 spent its hey-



GILLIS AULIARD

*Once a Texaco stunt plane, a 1929 Waco ASO will fly the 2003 tour...*







CAROLINE SHEEN



ERIK HILDEBRANDT

...as will the oldest surviving 1931 Stinson Tri-motor (at left) and a Ford Bushmaster, two of Herrick's rescues.

Herrick polishes the brushed aluminum nacelle of a "baby tri-motor," his 1929 Kreutzler K-5 Air Coach.

day working for small Alaskan airlines before winding up in Gene Frank's field in 1954.

Herrick prides himself on knowing detailed histories for each of the airplanes in his collection, which resides at the Anoka County-Blaine Airport outside Minneapolis. With the \$60 million he netted in 1994 from the sale of his mail-order computer business, Zeos International, he's built one of the largest private holdings of airplanes in the United States—40 in all, worth an estimated \$7 million.

Last April, I asked him for a tour. I wasn't sure what to expect. Herrick's boyish face, Eddie Bauer khakis, and plain cotton shirt hardly give him the look of the elite collector. He drives a red Jeep with roll-up windows and a cracked windshield. For his new job, owner and chief operator of the Aviation Foundation of America, he keeps a simple office in a warehouse-like building near some railroad tracks.

We sped along the roads north of Minneapolis, passing miles of flat, brown landscape. When we swung into a parking lot next to a hangar, I spied a small sign over a side door—"Golden Wings Flying Museum."

*By 1927, airplanes were a national craze. At the original tour's stop in Boston, crowds gathered for a closer look at the Ford 4-AT Tri-motor.*

I have never been so awed by the beauty of a practical object. What a difference between the aircraft inside the hangar and the 727 I'd flown on from Washington, D.C. Herrick's 1931 Stinson Tri-motor, deep blue with varnished wooden trim, reminded me that moving people through the air was once an artform. The collector delights in pointing out the craftsmen's attention to detail on all of his purchases: the fine wicker seats and brass handles on a Travel Air 6000, the quaint wheel covers on a 1935 Waco with a cream-colored fuselage and elegant red trim.

It soon becomes clear that every one of his airplanes comes with a story. During the two days we spent together, he never stopped chatting about the one-of-a-kind Sikorsky flying boat that he's spent \$600,000 to salvage from the bottom of a lake in Alaska (and so far gotten just a piece of the airplane's fabric to show for his efforts) or the number of calls he's had to make to track down the owners of a particular airplane he really, really wants. The rancher in Idaho, the mechanic in Florida, the widow in California—all are characters in Herrick's great airplane collecting adventure, and he takes great pleasure in reenacting the various parts. (On the way back from dinner, he played a mechanic sucking on a cigarette.)

"I was very interested in preserving history," says Herrick, and the era he

thought needed the most attention, he says, is the Golden Age of aviation. "That isn't to say that there aren't a lot of people saving Wacos and Travel Airs, but what really interested me was those that had disappeared or almost disappeared. It's like anything you develop an interest in—wine, cars—you start to refine it into categories you're interested in. I decided I was going to save one-of-a-kind vintage airplanes from the Golden Age."

He also decided that for the centennial year of flight, he was going to find an appropriate way to celebrate the contributions of the Golden Age, and that decision has brought him to his latest, greatest story. To tell as many people as possible about one of aviation's great eras of invention, Herrick is re-creating the Commercial Airplane Reliability Tours, which flew between 1925 and 1931, were sponsored by Henry Ford, and stimulated a remarkable transformation in air travel.

Prior to 1925, people saw airplanes as something used only by a daring stunt pilot or barnstormer, not by an average Joe wanting to go someplace. A few entrepreneurs and industrialists saw the airplane's potential: William Rockefeller, Cornelius Vanderbilt Whitney, Philip Wrigley, and Lester Armour all put up capital for airlines bidding on mail routes. But the capitalist most responsible for transforming the air-



# The 2003 National Air Tour Thrills for Sale

Besides bringing rare vintage aircraft to 26 U.S. cities this fall, the National Air Tour will also bring a chance to experience airplanes as many did during aviation's Golden Age. Rob and Bob Lock of Powell, Ohio, creators of the barnstorming act Waldo Wright's Flying Service, are selling rides on impeccably restored New Standard D-25 and D-29 biplanes, finished in "Stinson maroon" and "Diana cream" Poly Tone paints. The New Standard was designed for the 1920s barnstormer Ivan Gates, whose Gates Flying Circus traveled the country selling airplane rides in the D-25's roomy, open, four-passenger front cockpit. At six-foot-ten, Rob Lock is delighted with the room in the D-25. His flying service will offer rides at most overnight stops on the tour. (Check [www.waldowrights.com](http://www.waldowrights.com).)

Clay Adams of Rosemount, Minnesota, will also join the tour. A pilot for a major airline, Adams has for the past six years been selling rides across the upper Midwest in the two-passenger open cockpit of his Travel Air E-4000. "It's such a sweet-flying machine," Adams says. Like the New Standard, it was perfect for flying to a farmer's field, where it could scoop up paying passengers for joyrides. One of Adams' favorite events takes him to Hastings, Minnesota, where the host of an antique tractor show mows a strip in his alfalfa field for the Travel Air.

A tour Web site ([www.nationalairtour.org](http://www.nationalairtour.org)) will report the group's progress and arrival times at airports on the route.



GILLES AULIARD

*Splendor in the grass: Rob Lock's New Standard D-25 lands easily on rural airstrips.*

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**Tuesday, Sept. 9**  
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Milwaukee>Wausau>  
St. Paul

**Thursday, Sept. 11**  
St. Paul>Mason City>  
Des Moines>  
Kansas City

**Friday, Sept. 12**  
Kansas City>Wichita

**Saturday, Sept. 13**  
layover Wichita

**Sunday, Sept. 14**  
Wichita>  
Tulsa>Fort Worth

**Monday, Sept. 15**  
Fort Worth>Shreveport>  
Little Rock

**Tuesday, Sept. 16**  
Little Rock>  
Memphis>Birmingham

**Wednesday, Sept. 17**  
Birmingham>  
Atlanta

**Thursday, Sept. 18**  
Atlanta>  
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Winston-Salem

**Friday, Sept. 19**  
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*Lined up at Pitcairn Field, Pennsylvania, a typical stop on the 1927 route. Flying in the Stinson Detrouiter (shell logo), Eddie Stinson went on to win that year, with young Rosemarie Schlee along for the ride.*



INSET: WWW.NATIONALAIRTOUR.ORG





LEFT: XAVIER MÉAL; BELOW: TOM DEBRUIN

plane from a novelty into a necessity was Henry Ford.

Ford got into the airplane business in 1922 by investing in the Stout Metal Airplane Company, created by William Stout, an engineer who introduced all-metal construction into the manufacture of U.S. aircraft. Ford soon combined Stout's ideas with a few of his own to produce the Ford Tri-motor 4-AT. He knew he'd have to build a market for his new product, just as he had built a market for his cars. Encouraged by his son Edsel, he decided to sponsor an airplane tour that would show Americans how sturdy and reliable airplanes had become. He modeled it on the Glidden Reliability Tours, which had opened people's minds to the possibility of car travel. (Financed by Charles Glidden, who made his fortune in the telephone industry, the tours brought automobiles into towns all over the United States between 1905 and 1913 and fostered competition among the manufacturers to build the sturdiest car.)

In 1925, the Fords commissioned a \$7,000 sterling silver trophy and invited 17 pilots to fly a 1,900-mile route, with stops in over a dozen cities. Edsel himself waved the starter flag at Ford Airport in Dearborn, Michigan. There was no winner or loser in the

*Herrick's 1929 Fairchild FC-2W2 is a celebrity: The first airplane the NACA bought, it later flew for the National Park Service. Right: Why a giraffe? Dick Jackson's 1931 Sikorsky S-39-C honors the type's role in African expeditions.*



first race. To emphasize reliability and safety, rather than speed and daring, a committee set up an elaborate equation that measured the accuracy and quickness of pilots' takeoffs and landings and their average cruising speed between the various stops on the tour. Any pilot who sustained the required cruising speed at least 75 percent of the time and met other performance criteria could win a perfect score and get his name engraved on the imposing three-foot-tall trophy. (Things turned more competitive the following year, when only the top point-getter was honored.)

In a 1929 article in *Aviation* magazine, Ray Collins, a former World War I pilot who refereed or managed all seven tours, recalled the 1925 debut: "We had six days of awful weather,

continual rain and storms, including a cyclone in Kansas City. Servicing for the ships was very poor too. Gas was poured into the tanks by the bucketful and gas mileage was lousy so you could only go 175 miles in a day.

"The average crowd at the various airports was about 3,000 persons. The interest at that time seemed to be more in going out to see a group of daredevils fly. The idea of the general public themselves taking a trip in the air was not brought home to them then."

That was the attitude Ford was trying to change—not only with the air tour but with the three-engine aircraft his company would build. The Ford Tri-motor projected a look of steadiness and safety, an image necessary for com-



mercial flights to catch on in the United States. For passengers who might doubt the safety of an aircraft that relied on a single engine, the tri-motors provided two backups. The early Ford Tri-motor, like the one Herrick coveted in the rancher's field, and its Stout 2-AT predecessor were nicknamed "Tin Goose" for their aluminum alloy construction. (The Tri-motor also got the name "Flying Washboard" because of its corrugated skin.) One of the first all-metal, multi-engine transports, the Tri-motor underwent a number of refinements over the years and eventually became the workhorse for more than 100 airlines in a dozen countries.

In 1926, the year of its introduction, a Ford-Stout Tri-motor 4-AT-A, with a

pilot and four passengers, flew in the second Commercial Airplane Reliability Tour, along with 24 other pilots, who traveled 2,600 miles to 13 cities, before huge crowds. In the 12 months since the first tour, airplane design had undergone enormous changes. Unlike the Swallows, Yackeys, and Martins on the 1925 tour, all but two of the aircraft had the new air-cooled radial engines, wheel brakes, and a much larger carrying capacity.

Charles Lindbergh's solo Atlantic crossing in 1927 fueled a nationwide obsession with aviation. The Midwestern airmail carrier made Americans curious about airplanes the same way a great athlete can trigger the nation to embrace a previously ignored or mis-

understood sport. The 1928 Ford tour rode the wave of interest to a banner year complete with 25 pilots, who flew a 6,300-mile route to the delight of millions of spectators.

Collins recalled: "The crowds at the airport had grown to 18,000 a visit and many of the visitors were eager to take their first ride." Just three years had passed since the first tour, yet the Ford air tour brochure now carried ads from airlines announcing passenger routes. (A hop from San Francisco to Seattle took seven hours and cost \$55.) Henry and Edsel's vision of establishing a highway in the air for the average American no longer seemed like a fantasy.

At about 9 a.m. on Monday, this





September 8, Edsel B. Ford's grandson, Edsel II, will wave a starter flag at the Dearborn Proving Ground, formerly Ford Airport, near Detroit. When he does, 30 airplanes—several Ford Tri-motors, other early airliners, mail carriers, bushplanes, amphibians, and barnstormers, accompanied by the last Douglas DC-3 to be operated by the FAA—will begin the 26-city 2003 National Air Tour. The aircraft will fly 4,000 miles, following a route planned for the 1932 tour, which was canceled when towns suffering from the Depression simply couldn't find the money to welcome touring airplanes.

As Herrick heads the re-creation of the early Ford tours, he is tackling many of the details the original orga-

nizers faced: lining up sponsors, pilots, airplanes, airfields, and ground crews. "Imagine the logistics," he says, "for 30 airplanes all going 110 mph and leaving Dearborn at basically the same time on September 8."

But he doesn't dwell on the nuts and bolts. When I ask him about the task of organizing the tour, he answers by describing how much it means to the pilots who will fly their Golden Age airplanes this fall and telling me about Rosemarie Schlee, at 87, the last known living participant of the original tours.

Her father, Ed Schlee, flew two-thirds of the way around the world in 1927 (he skipped the Pacific Ocean), just after Lindbergh won the Orteig Prize, awarded for the first solo non-stop flight from New York to Paris. "Airplanes were our business," Rosemarie says today. "We owned an airport. I remember my dad gave me a parachute and hung me from some



*Anthony Fokker (back right) entertains company executives in the 10-passenger Fokker Tri-motor just days after the airplane debuted in the 1925 Commercial Airplane Reliability Tour. The Fokker F.7 Tri-motor rivaled Ford for airline customers and made history when Richard Byrd chose it for his 1926 North Pole expeditions.*

*American Airways alums: Addison Pemberton's Stearman 4-DM (left), one of five surviving, carried mail; Herrick's Stinson Tri-motor, American's oldest surviving airliner, carried passengers.*



GILLES AULIARD



ABOVE: WWW.NATIONALAIRTOUR.ORG; BELOW: CAROLINE SHEEN





*With the specially built Travel Air B6, Walter Beech (left) and Brice Goldsborough won the 1926 tour.*

rafters to show me how to use it.”

In 1927, Rosemarie, then 12, flew in the Ford air tour with her father in the family’s Stinson S-1. Schlee had Eddie “Lucky 7-11” Stinson, founder of the airplane manufacturing company of the same name and one of the finest pilots of the era, at the controls. That year, dressed in a well-pressed business suit and straw hat, Stinson won with ease, his suave style convincing one newspaper reporter that “flying is not the strenuous proposition it used to be.”

Rosemarie recalls the lavish lunches and dinners various towns put on for the pilots and their passengers. People crushed in on the field and the airplanes. “We flew to New York and I couldn’t believe how many people showed up. It was like we were coming back from the moon or something.

“The planes were very comfortable and had wicker seats. And I remember Dick Blythe [a reporter] from the *Detroit News* had a little monkey named Whirlwind Jimmy. We’d land at all of these airports and the kids would be following me and the monkey would be sitting on my shoulder holding onto my hair. I’ll never forget the kids trailing after me.”

To honor people like her father and Stinson, Rosemarie wants to participate in the National Air Tour this fall, but she’s had heart surgery and back

problems and can’t be sure she’ll show.

It’s first-person accounts like hers that bring back the innocence, energy, and fun of the era, during the administrations of Calvin Coolidge and Herbert Hoover, when nearly half of Americans lived on farms, and men with an idea and some cash could design their own airplanes.

After winning the 1929 tour in a Waco 225, John Livingston wrote a day-by-day account of his three-week adventure for *Aviation*. “While the total number of hours I have in the air is not excessive,” Livingston wrote, “much of my experience has been in virgin cross-country work. As a result, I think that perhaps I have developed a knack of recognizing little things that help me stay on course.”

The original tours focused on manufacturing towns, rather than big cities like New York or San Francisco, so there was a small-scale quirkiness to the whole escapade. In 1928, the city of Wausau, Wisconsin, population 18,000, offered \$1,200 and the honorary title “Air Mayor of Wausau” to the pilot voted into office by the Wausau citizenry. The manager of the town airfield, John Wood, was competing in a Waco 10, painted with the Baby Ruth candy bar insignia. He attached parachutes to small candy bars and dropped them over the side of his aircraft to the crowds. He became the hometown hero, and new Air Mayor of Wausau, when he won the tour. But in a pattern all too common for pilots at the time, he died the following year over the California desert when lightning hit his Lockheed Vega. Wausau (current population 40,000), which named a street near the airport after Wood, will be one of the stops on the 2003 tour.

Greg Herrick can’t get enough of these stories. To him, all of the Wacos, Stinsons, Ryans, Fairchilds, Birds, Cabinaires, Stearmans, Travel Airs, and Sikorskys that flew in the tours represented a creative flash in the commercial aviation industry that disappeared with the rise of long production lines at the advent of World War II.

“Everyone is into warbirds, which is just great, but, frankly, the world doesn’t really need another [restored] P-51,” he says.

“I figured if I was going to put in all this time and money I wanted something unique,” says Andrew King of Elwood, Virginia, who plans to fly his 1926 Ryan M-1. “It’s a monoplane from a time when almost all of the planes were biplanes. It was used on airmail routes a lot between Los Angeles and Seattle.”

Addison Pemberton of Spokane, Washington, also has an affinity for the airmail carriers. In 1993 he decided to re-fly the San Francisco-to-Chicago run in his Stearman 4E Speedmail with his buddy Ben Scott, another pilot who will fly in the September tour.

“We were sworn in as airmail pilots and carried 3,000 letters. I had my two boys with me—they were small at the time—we had airmail bags and everything.”

Pemberton continues: “At the time an automobile could go about 35 mph while the planes could fly 110 or so. These planes were like space travel. And the designs were so amazing. Many of them could outperform a Cessna or other modern small airplanes.

“Even today it’s really fun to circle a small town and then land and see the cars pull up and the kids run over. I call them our unfranchised America trips—no Days Inn or McDonald’s. In an airplane you can avoid seeing modern America when you fly at 4,000 to 5,000 feet and then land in a field.”

Dave Allen, who will fly his 1930 Waco ASO in the tour, is “so grateful to relive the Golden Age of aviation. The more we share about it the happier we are.” He says he and his wife Jeanne are “just a couple out in the middle of nowhere in Colorado having a good time flying our Waco.”

For people like Herrick and other owners of Golden Age aircraft, the rides and the carefully restored Wacos, Stinsons, and Ryans are all about spreading the news. No one sells these airplanes on a whim or just for the money. The enthusiasts talk among themselves about each new discovery in some rancher’s field, and want to be sure no single collector corners the rare-bird market. When Herrick first started buying up lots of Golden Age airplanes in the 1990s, “there were some hard feelings initially,” says Pemberton. “But it turns out he’s a nice guy and he sends



his planes to all sorts of small-time airshows, which is really decent of him. I'm a bottom feeder [in the collection business] and he talks with me."

To be a member of the Golden Age collectors' community, you have to share the airplanes, share the stories, and feel a strong emotional connection to the era the airplanes represent.

Near the end of my tour of Herrick's collection, we pause in front of a beat-up 1928 Stinson-Detroit SM-1B with a jammed door and torn fabric. Of course, Herrick has to share the wounded relic's story: "This airplane made the first diesel-powered flight. Look at the shoelaces around the fuel tank. That way when they had to replace the tank they could easily pull these off without tearing the wing apart."

He bounds around to the tail and pokes his head inside a tear in the canvas. "Hey," he shouts with alarm, "someone didn't clean the grass in there, did they?"

The mechanic who helped us open the airplane's door insists he hasn't cleaned anything.

"I liked it because it was from 1930. That was 1930 grass in there."

Herrick's right. Such details do help bring it all to mind. The Packard diesel motor roaring away, the pilot charging toward a chalk-lined grassy strip that's supposed to pass for an airfield, the soft soil pulling on the wheels, the grass catching in the small tear in the fabric, the local people lining the field, just dying to rush in and touch what they see. —



DELTA AIRLINES

*Every airplane has a story (from top): Delta Air Lines gussied up a 1931 Travel Air 6-B to look like its first passenger craft; Fokker's rugged 1929 Super Universal (sans dancing girls) underwent an 18-year restoration; a father and son fly this pair of New Standards.*



GARTH PRITCHARD



CAMERON DAVIDSON



FINICKY PLANTS,  
MECHANICAL MISHAPS,  
DOTING COSMONAUTS,  
AND THE QUEST TO  
BUILD A SPACE  
SALAD MACHINE.



Pea:  
*Pisum sativum*



# GROWING PAINS

by Robert Zimmerman

Each evening, after doing his exercises, Viktor Patsayev glided over to Oasis, a little square greenhouse attached to a wall of the Salyut 1 space station, to water the flax plants inside. A sad-faced man with a precise manner, Patsayev would push a handle to pump water from a reservoir into the layers of resin that held the seeds. After about a week, two little flax shoots poked up through the artificial soil. Patsayev and crewmate Vladislav Volkov carefully tended to the fragile seedlings like parents. The cosmonauts seemed to be cheered by them. “These are our pets,” Patsayev said. “They are our love,” noted Volkov unabashedly.

Scientists at Energia, the agency responsible for the Soviet manned space program, had not designed the greenhouse to comfort the cosmonauts on the 1971 mission. Oasis and its flax plants were among the first experiments that looked toward the future—when colonies in orbit, or bases on the moon or Mars, would depend on space agriculture to help recycle oxygen and feed their crews. Until humans learned how to grow crops in microgravity, the cost of resupplying such outposts would be prohibitive, and lengthy missions away from Earth would be impossible. And like all facets of the space race, growing crops was something the Soviets wanted to do first.

Still, Energia’s scientists were so impressed with the psychological effects exo-gardening had on cosmonauts that by the time Salyut 6 was launched in the late 1970s, the Soviets had begun to think of the research in a new way—as a tool to boost crew morale. In 1979, when Valeri Ryumin and Vladimir Lyakhov struggled with loneliness and depression during their unprecedented half a year in space, Energia sent interior decorations—flowering tulips and a mature kalanchoe plant—to the station via a resupply vehicle. Ryumin and Lyakhov were cheered immediately. They named the kalanchoe “life tree” and made sure it was always in the picture during television broadcasts from the station. Later, aboard Salyut 7 in 1982,

Valentin Lebedev observed that gardening calmed him. “I water the plants regularly, happily,” he wrote in his diary. “I spoil them; I am too generous with water.”

Yet despite the ancillary emotional benefits, the primary goal of raising crops from seeds in microgravity was not to be easily reached. A long road lay ahead for scientists. They were to be frustrated by plants’ fickleness, hampered by a series of unsuccessful greenhouse designs, and thwarted by unforeseeable factors and events.

Soon after Salyut 1’s flax shoots emerged from the resin, it became apparent that they were suffering; their leaves seemed small, and they grew far slower than flax shoots on Earth. Botanists at Energia and the Institute of Medical and Biological Problems (IMBP) in Moscow waited eagerly for samples to be returned for study, but it was not to be. On June 29, Patsayev, Volkov, crewmate Georgi Dobrovolsky, and their plants died when their Soyuz descent capsule depressurized while reentering Earth’s atmosphere. Without live samples, Soviet scientists could only guess that the plants’ problems had something to do with Oasis’ watering system—the cosmonauts had noted that it seemed to work poorly.

Four years later, aboard Salyut 4, crews again tried to grow plants. Oasis had been redesigned so that water could be automatically and precisely administered—or so Soviet scientists thought. Pea plants and onion bulbs grew slowly, then died. “First the water didn’t go in, then it went the wrong way,” wrote cosmonaut Georgi

Flax:  
*Linum  
usitatissimum*



**THE LIMITED ENVIRONMENTAL CONTROL SYSTEMS ON SPACECRAFT AREN'T TUNED TO DEAL WITH VEGETATION; IN FACT, BOTANISTS WOULD LATER DISCOVER THAT ONBOARD ATMOSPHERES ARE OFTEN TOXIC TO PLANTS.**

*Arabidopsis thaliana*



COURTESY MIPS

Grechko. In a zero-G environment, there is no way for water to be naturally distributed to roots that grow in all directions. On Earth, water hits the soil and is pulled downward by gravity to where a plant's web of roots can absorb it, but in orbit, the water that the cosmonauts pumped into the artificial soil simply stayed put, waterlogging some areas and leaving others parched. Energia botanists needed to devise a system to bring roots and water together.

From 1977 to 1981, five crews on Salyut 6 lovingly attended to an assortment of flora, once more attempting to nurture plants and vegetables through an entire growth cycle—from seed to plant to seed to plant. To improve the crews' odds for success, botanists sent up a variety of greenhouses. Oasis was revised to better distribute water. Another greenhouse, which resembled a foot-wide metallic starfish, rotated to create centrifugal force, allowing cucumber and flax seeds to grow in simulated gravity. The structure was called Biogravistat, and from it scientists would learn that plant cells could respond to as little as .0001 G. Vazon

containers, a third method, were designed to grow bulbs like onions and tulips and were periodically rocketed to the station. Bulbs would be placed in a container's base and then topped with cone-shaped covers that directed the growth of sprouts while the base was filled with water.

Inside Fiton, a greenhouse the size of a coffee table book, attempts were made to grow *Arabidopsis thaliana*, a weed often found in junkyards and dumps. The species had been chosen because its entire life cycle was only 40 days. To sow an *Arabidopsis* seed, a cosmonaut released a spring, which caused a plunger to push a seed into one of five glass cups of nutrient-saturated artificial soil. The plant was then to grow on its own, with no watering necessary.

Like Patsayev and Volkov, crew members aboard Salyut 6 cared for the plants like doting fathers. One cosmonaut, Vladimir Kovalenok, used what he called the "simple peasant's way" to help the onions grow, carefully trimming rotting stalks as they poked out of the Vazon's top. To his delight, the trimming helped the healthy stalks grow faster. Still, the onions died prematurely from thirst—without gravity, even proximity isn't enough to enable roots to absorb water.

Though their greenhouse designs were clever, Soviet botanists were hampered by government secrecy, which forbade them from publishing detailed scientific papers. Scientists, including Galina Nechitailo, a space botanist from Ukraine who was a major player in Energia's plant research program, weren't allowed to reveal their research. "It was a totally secret program," Nechitailo says. "I couldn't move about. I was forbidden to go anywhere."

Nechitailo routinely gave advice and instructions to Salyut 6's cosmonauts in an effort to improve the plants' chances. In one conversation, Kovalenok's crewmate Alexander Ivanchenkov repeatedly hinted to Nechitailo that he couldn't possibly use all the onion bulbs on board for their plant experiments. Why did they need so many? How should he store them? Did she plan some other use for them? Nechitailo took the hint. "Keep the four best onions for the experiment and use the rest as you like," she said. Ivanchenkov gleefully responded, "Thanks, I've been probing for that," and ate the extras.

He would not be the only cosmonaut to take advantage of Salyut 6's plant experiments. Two years later, as he prepared for a second extended stay, Ryumin decided to smuggle aboard a cucumber from his launch-day breakfast. During the mission's first space telecast, fellow cosmonaut Leonid Popov panned his camera to one of the station's greenhouses. Among the dead stalks and seeds left over from the last crew eight months earlier sat one full-sized cucumber. Ryumin innocently explained that it must have grown during the cosmonauts' time away. Everyone in mission control was speechless. After peppering the men with questions, scientists on the ground concluded that it was a joke and the cucumber was plastic. "We should have taken a bite while we were on television!" Ryumin thought afterward.

Despite the cosmonauts' humor, space gardening remained difficult, though Ryumin proved to have quite a green thumb. He cultivated onions, peas, radishes, lettuce, wheat, garlic, cucumbers, parsley, and dill from ready-grown sprouts that were delivered to the station by space freighters, and he turned the space station into a veritable jungle by growing them in empty film cassettes, equipment casings, and food containers hung everywhere on the station's walls. But his and Lyakov's attempts to get seeds to reproduce proved futile. Despite



the best efforts of several crews, most of Salyut 6's seeds grew poorly or died. Like the flax plants aboard the first Salyut, those that managed to sprout were tiny and stunted. Later, Ryumin would write that it seemed as if the seedlings petered out once they'd used up all the nutrition contained in the seeds themselves.

Perhaps the cosmonauts should have expected as much; over eons, the plants they were testing had evolved physiologies dependent on a terrestrial environment that was yet to be replicated well in space. On Earth, plants need lots of sunlight and water, and vast areas of land to thrive, but spacecraft have little spare power or room, and their limited environmental control systems aren't tuned to deal with vegetation; in fact, botanists would later discover that onboard atmospheres are often toxic to plants.

Ryumin and Popov's failure was not in vain. The greenhouses were revised again,

and on the next long-term mission aboard Salyut 6, Vladimir Kovalynok and Viktor Savinykh got an *Arabidopsis* plant in the Fiton greenhouse to bud, the first time seed heads (the pods in which seeds normally grow) had ever appeared in space. Though the heads were sterile and seedless, Ryumin, now working in mission control, wondered whether the latest Fiton design, which kept the plant's atmosphere separate from the station's, had accounted for the success.

His guess was correct. Salyut 6's atmosphere recycling equipment was unable to purify the air thoroughly enough for plants to prosper. On this and previous missions, unexpected trace gases released by the station's equipment, food, and human crew had stifled plants exposed to the crew cabin. Consequently, the Soviets put a new suite of greenhouses on their next space station, Salyut 7, which launched in 1982.

As flight engineer of the Salyut 7's first crew, Valentin Lebedev was in charge of the

KURT STÜBER/BIOLIB.DE



Onion:  
*Allium schoenoprasum*

## THE INTERNATIONAL SPACE STATION'S LADA GREENHOUSE

**Fans.** Keep air circulating around the plants and cool the greenhouse.

**Sensor Tree.** Measures temperature and light at 3 levels.

**Substrate.** Nourishes plants with artificial soil and time-release fertilizer.

**Wicks.** Cradle seeds and roots; keep plants in contact with water.

**Sensors.** Can be configured to include moisture probes, soil probes, oxygen sensors, and tensiometers to measure surface tension of water.

**Light Module.** Houses lamps and fans, infrared temperature sensor, digital camera, and relative-humidity sensor.

**Lamps.** Off-the-shelf fluorescent bulbs.

**Leaf Chamber.** Reflective film inside the 10-inch-tall chamber maximizes light directed to plants.

**Pumps.** Supply water to porous tubes; triggered by a computer that reads sensor data.

**Root Module.** 3.5-inch-tall box contains electronics that interface with Lada's computer controls.

**Water Tank.** Rigid exterior protects a 5-liter Teflon bag inside and prevents it from bursting.

**Porous Tubes.** Four perforated stainless steel tubes deliver water to wicks and substrate.

**ON AUGUST 4, PODS APPEARED ON THE PLANTS. LESS THAN TWO WEEKS LATER, LEBEDEV ANNOUNCED WITH GLEE, "HURRAH! A POD HAS BURST: IT SPILT SEEDS!" IT WAS THE FIRST TIME SEEDS HAD DEVELOPED IN SPACE.**



BY SEPTEMBER 1997,  
FOUR OF FOALE'S SIX  
SEEDS HAD  
GERMINATED, GROWING  
LEAVES AND PODS  
PACKED WITH SEEDS.  
AFTER ALMOST THREE  
DECADES OF EFFORT BY  
BOTH SOVIETS AND  
AMERICANS, A SECOND  
GENERATION OF  
HEALTHY PLANTS HAD  
BEEN GROWN IN SPACE.

plant experiments. Inside Oasis, the roots of pea plants grew wildly while their leaves suffered from brown and white molds. Soon the plants died. Svetoblok, yet another greenhouse module, produced a stunted tomato plant. But inside a Fiton module that used anti-bacterial filters to keep the air pure, a breakthrough was emerging.

Since launch, Lebedev had mostly ignored Fiton because its watering system worked automatically and nothing seemed to grow. But in July, after months of inactivity, tiny *Arabidopsis* stems wove their way out of the artificial soil. They looked more like loose floating jumbles of thin twine than plants. On August 4, pods appeared on the plants. Less than two weeks later, Lebedev announced with glee, "Hurrah! A pod has burst: It spilt seeds!" It was the first time seeds had developed in space.

To Nechitailo, the seeds were worth more than gold. "Keep them safe," she told him anxiously. "We need them all alive." Lebedev harvested roughly 200 space-grown *Arabidopsis* seeds. Once back on Earth, they quickly germinated and produced healthy plants. After more than a decade of effort, the Russians had finally proven that plant life could reproduce in space, and that future space explorers could grow their own food. Space didn't have to be a barren and lifeless place.

**D**espite this triumph—which should have propelled the Soviet space biology program to even greater achievements—a series of accidents and political changes stopped the program in its tracks. Most of Lebedev's *Arabidopsis* seeds were lost in an attempt to launch them back to Salyut 7 for further experiments. When Soyuz T-8 failed to dock with the space station, the crew capsule separated to return to Earth, and the orbital module in which the seeds were stowed was abandoned to burn up in the atmosphere as usual. Then, in February 1985, Salyut 7's batteries drained, leaving the unmanned station frozen and dying. A rescue crew revived the station, but Soviet botanists decided to concentrate their energies on Mir, which launched in 1986.

However, Communist party general secretary Mikhail Gorbachev's efforts to reform the Soviet Union had extended to its

space program as well. On board the new space station, pure scientific research was de-emphasized, replaced by a focus on commercial profit. Mir's only greenhouse, a Bulgarian-Russian unit dubbed Svet, had been included mostly for political purposes and was far less advanced than earlier Russian greenhouses. "Technologically it was similar to Oasis, 20 years before," says Nechitailo. "We couldn't learn anything from it." Except for one failed attempt to grow wheat in 1991, the effort by Nechitailo and her partners at Energia and IMBP to grow plants in space was over, leaving unanswered the question of whether seeds produced in space could grow and produce viable second-generation seeds in orbit.

By the time NASA and the Russian space agency began a partnership in 1996, the Soviet Union had disintegrated and Nechitailo, who was closely tied to the Soviet power structure, had been forced out of the agency's plant research programs. NASA brought new ideas and new equipment to Mir, and infused the program with a large amount of cash.

The first great success came with American Michael Foale's stay on Mir in 1997. In May of that year, Foale planted 52 seeds of *Brassica rapa*—better known as mizuna, a wild plant that produces tasty light-green leaves that can be cooked, mixed in salads, or simply plucked off and eaten. Like *Arabidopsis*, its life cycle is short; it flowers only 14 days after being sown. It is also resistant to ethylene, a gaseous plant hormone that tended to linger in Mir's atmosphere and had been blamed for ruining a past wheat-growing experiment. Foale's plan was to coax two generations of seeds from the mizuna seeds.

During previous missions to Mir, U.S. astronauts had refurbished the Svet greenhouse. "We worked with the Bulgarians to get new components built for Svet," says Gail Bingham, a professor in the Plants, Soil, and Biometerology Department at Utah State University. Bingham's USU team developed sensors that monitored the amount of moisture reaching the roots as well as the carbon dioxide and oxygen levels surrounding the plants. The team installed light banks and new fans to keep the greenhouse atmosphere circulating and clean of toxins, and replaced Svet's artificial soil with a set of fabric sheets that were packed with seeds and then folded around perforated stainless steel watering tubes. Both the tubes and fabric were then



KURT STÜBER/BIOLIB.DE (2)



enclosed in a calcite clay embedded with pellets that released nutrients over time.

After four weeks—twice as long as it would take on Earth—the plants were ready to be pollinated. Foale became a human bee, collecting pollen from the one- to two-inch plants and depositing it on their stamens, but his efforts were almost for naught—a Progress resupply vehicle collided with Mir. Damages and emergency maneuvers cut into the station's power supply. The plants floated in darkness for three days, with no fans to circulate the air around them. Temperatures dropped to near-freezing. But just days after power was restored, several plants developed seed pods. "It was pretty clear that they were full of seeds," Foale remembers. In between putting Mir back together—shifting batteries about and wiping up globs of water—Foale carefully harvested the pods, reserving half the seeds for return to Earth and preparing the rest for replanting in space. He gently inserted a half-dozen seeds back into Svet's root modules.

For the next month, he helped each seed find light, delicately feeding them a precise amount of water. By September 1997, four of Foale's six seeds had germinated, growing leaves and pods packed with seeds. After almost three decades of effort by both Soviets and Americans, a second generation of healthy plants had been grown in space. Six seeds were planted on Earth; two of them developed into viable plants, and the vision of self-sufficient space exploration seemed a little closer to reality.

Since Foale's success, work has continued, first on Mir and then on the International Space Station. In 1998 and 1999, Russians on Mir were able to grow two generations of wheat, with the second generation producing healthy offspring back on Earth. In 2001, astronauts on ISS again grew *Arabidopsis* through an entire life cycle, confirming the work Lebedev had done two decades earlier.

In 2002, Utah State University's Space Dynamics Laboratory and the Russian space agency teamed up to build a greenhouse dubbed Lada (after the Russian goddess of spring, with a nod to the boxy Soviet car) and installed it on the Russian side of the ISS. Lada's aim is to grow edible vegetables instead of crops. "We aren't ready yet to grow wheat and turn it into bread," says Bingham. "Instead, we are trying to grow a salad machine."

The costs of Lada's design, construction, approval, and flight were many times less than they would have been if the greenhouse had been submitted to the complicated and time-consuming bureaucratic process NASA requires to get an experiment into space. Bingham says the U.S. side of the partnership contributed only about \$300,000—a figure that owes much to free work done by USU students. There is no estimate of the amount contributed by the Russians. Bingham notes, "If you are really lucky and really well thought of in the NASA community, you might get two or three experiments in your lifetime. In contrast, we've already flown 10 experiments on Mir and the Russian side of ISS over 10 years."

The Russian crew members spend their personal time tending Lada's garden in exchange for the right to eat half their crops; the other half is reserved for analysis. Last November, cosmonauts reaped Lada's first crop of leafy greens, greedily devouring half a harvest of *Brassica rapa*. (NASA would not grant permission for U.S. astronaut Peggy Whitson to eat any—the greens had not been certified as safe for consumption—though her hand did mysteriously appear in a photograph of cosmonauts munching on their work.)

Like their Soviet predecessors, Bingham's astro-farmers have been so taken by their work that they're no longer automatically agreeing to do the tests Bingham and the other scientists propose. "They've become just as good at farming as we are," says Bingham of the cosmonauts. "We think we ought to do something to the plants, and they'll tell us, 'I don't want to do that.' They know what's best for the plants."

Not that Bingham is really complaining. His goal is the same as that of the pioneering botanists who developed greenhouses for the Salyut stations: to make it possible for space explorers to feed themselves, no matter how far they may be from Earth. Lada's success leaves Bingham optimistic that future space gardens will significantly reduce food shipments from Earth. "We hope to grow peas, mizuna, and radishes," he says. "Enough to where we are providing crews with an occasional salad." And, perhaps, a certain amount of good cheer. ➔







*The Comet's sleekly modern look raised the public's confidence in the new mode of jet-propelled passenger flight. But military and economic uncertainties about the Comet made U.S. politicians nervous.*

FOR A BRIEF, STRANGE MOMENT,

THE BIGGEST THREAT TO POST-

WAR AMERICA WAS THOUGHT TO

BE POSED BY THE BRITISH.

## NEW SOVIET JET REPORTED

Paper Says 850-Mile-an-Hour Bomber Is in Full Production

WASHINGTON, Jan. 19 (AP)—The American Aviation Daily, a trade newspaper, said today it has learned that the Soviet model 150 twin-jet medium bomber was in full production. It said the information came from a contact

however, that no date was fixed for hearing Bedell Smith, who is Under Secretary of State, whether there had been General Smith's nomination. Willey replied that he would leave office. Mr. Acheson leaves noon today.

# THE COMET AFFAIR

BY JEFFREY A. ENGEL

...ed him for "business" and presented silver tray to him as a present. The Soviet Embassy among the missions that contributed to the gift. Ambassador Wilhelm Mu... Morgenstern... of...  
...former chief engineer of the Junkers factory in Germany, the publication said. It is reported to have a range of 2,250 miles and an altitude capa...



AY, SEPTEMBER 12, 1950.

# ATION BRITISH JET STIRS QUERIES ON SOVIET

Experts Think Russians May  
Have Built Similar Plane  
With Engines London Sent

LONDON, Sept. 11, (UP)—Avia-  
tion experts took a long look at  
Britain's "fastest interceptor plane  
in the world" today and said the  
Soviet Union might have developed  
one almost as fast from jet en-  
gines shipped to Moscow by the  
Labor Government.

The controversy over fifty jet  
aircraft engines supplied to the  
Soviet Union four years ago came  
to a head after British  
planes

# FAIR

very few years," one British ex-  
pert said.

The Soviet Union, with the aid  
of expert German engineers taken  
here after World War II and  
known to be working on jet de-  
velopment outside Moscow, could  
have carried out similar experi-

## On May 3, 1952, the cool quiet

OF AN ENGLISH MORNING WAS BROKEN BY FOUR JET  
ENGINES SCREAMING TO LIFE. A BRAND-NEW AIRLIN-  
ER WAS ABOUT TO MAKE HISTORY, INAUGURATING  
THE WORLD'S FIRST COMMERCIAL JET SERVICE. SLEEK,  
FAST, AND WHOLLY WITHOUT PEER, THE COMET, OWNED  
BY BRITISH OVERSEAS AIRWAYS CORPORATION, HELD  
36 BUSINESS EXECUTIVES, LUXURY TRAVELERS, AND  
DISTINGUISHED GUESTS OF THE AIRLINE AND THE AIR-  
PLANE MANUFACTURER, DE HAVILLAND AIRCRAFT.  
THE COMET'S MAIDEN VOYAGE: A MULTI-STOP JOUR-  
NEY FROM ENGLAND TO SOUTH AFRICA.

It was a flight that signaled a new age of travel. The Comet's  
four Rolls-Royce Ghost jet engines, each of which provid-  
ed 5,000 pounds of thrust, nearly halved the time needed to  
fly from one end of the British Empire to the other, reduc-  
ing travel time from London to Johannesburg from 36 hours  
to 23. With speeds like that, BOAC's chairman, Sir Thomas  
Miles, boasted, "New Yorkers will be able to take a swim  
in Bermuda and dry themselves at home."

Unprecedented speed was only half the Comet's allure.  
The aircraft's engines, advanced aerodynamic design, and  
the relatively new technology of cabin pressurization en-  
abled it to climb high above inclement weather—nearly twice  
as high as most airliners of the day—and cruise through  
skies of unprecedented calm. When the first group of voy-  
agers stepped onto Johannesburg's Palmietfontein Field—  
surrounded by 20,000 spectators lined up to witness the ar-  
rival—one young woman questioned by reporters paid the  
airplane the ultimate compliment: During the flight, she had  
fallen asleep.

The following year, BOAC began to equip a second gen-  
eration of Comets with Avon engines. Unlike the Ghosts,  
which used centrifugal flow, the Rolls-Royce Avon employed  
an axial-flow design, which shot air directly through the en-  
gine, a more efficient arrangement. Airlines from around the  
world lined up to purchase the Avon-powered craft.

British policymakers were hopeful that Comet sales would  
help give the nation the economic boost it needed in the  
years following World War II. Duncan Sandy, the United  
Kingdom's supply minister, wrote to Prime Minister Win-  
ston Churchill: "On whether we grasp this opportunity [for  
extensive Comet sales] and so establish firmly an industry  
of the utmost strategic and economic importance, our fu-  
ture as a great nation may to no small extent depend."





*President Dwight Eisenhower (below, left), Secretary of State John Foster Dulles (at right), and other U.S. statesmen urged Britain not to sell the Comet to other nations. But the cabinet of Prime Minister Winston Churchill (top) prevailed, and the sales strained the "special relationship" between the two countries.*

RAF warplanes would surely always outpace Soviet Bloc designs, and indeed, Rolls-Royce was already working on engines far more powerful than the Nene and Derwent. According to the British Air Ministry, "Rolls-Royce are confident that they will be able to keep several steps ahead of any country" to whom they sold an engine. From both military and commercial perspectives, Britain felt secure.

Then the Soviets came calling.

It was a proposition no one expected. In the spring of 1946, without even so much as an informal inquiry beforehand, Moscow sent an order for 20 Nene and Derwent engines. The order came accompanied by a threat: Failure to sell could further harm deteriorating East-West relations, and dash any hope of the British purchasing much-needed Soviet timber. Furthermore, the Russians had a long memory for slights.

Attlee's foreign secretary, Ernest Bevin, warned Attlee that the Soviets might be producing copies of the British engines in as little as three to five years; at one meeting he burst out: "How mad we are!" for even considering the sale.

He had a point: The Soviets had already proved themselves skilled and swift reverse-engineers. In 1944, the Soviets had taken three U.S. B-29s that had been "interned" in Siberia after the pilots had made emergency landings there in World War II's final months (see "Made in the U.S.S.R.," Feb./Mar. 2001); in three years the Soviets had broken the bombers apart piece by piece and produced copies of them, right down to the extra ashtrays and chewing gum containers U.S. pilots had rigged up in the cockpit.

Despite all the misgivings, Attlee felt he had to approve the Nene sales. By the summer of 1947, more than 50 engines had arrived in Soviet ports.

U.S. news media were quick to spread the startling news. "An outrage," one Washington newspaper exclaimed, while another editorialized that "few stories are of greater importance to the American public" than Britain's role in the deaths of American pilots. The news reports sent "all hell bucking loose on Capitol Hill," observed Under Secretary of State Robert Lovett. Air Force Secretary Stuart Symington brooded: "The British government has placed economic factors ahead of any present or future military implications which might be involved," a decision that "might have rather grave implications respecting the security of the United States." Lovett agreed. Selling advanced engines to the Soviets "was not only unwise but unnecessary," he roared at Lord Iverchapel, Britain's ambassador to the United States, but "also showed a surprising lack of cooperation" in the fight against global Communism. Any similar sale in the future "might have very far-reaching results in other matters affecting the relationship of our two governments." In other words: If Britain ever made such a move again, it might soon find itself dangerously alone.

That goal would not prove easily achieved. The United States objected to the sales, citing concerns that lax airline security in foreign nations offered innumerable opportunities for Communist agents to steal the technological secrets of the Avon. And with Avon-like engines affixed to their wings, Soviet airplanes might gain the range and the payload capacity to launch, for the first time, atomic strikes against the United States.

Theoretically, propeller-driven Soviet bombers operating from secret airfields far above the Arctic Circle could already hit most major U.S. targets (at least during the six months of the year the airfields were not iced in). But those lumbering airplanes would be pushed to the limit of their one-way range; they didn't pose nearly as big a threat as long-range jet bombers capable of outflying U.S. defenses and returning safely home.

The United States had another reason to fear British technology ending up in Soviet aircraft. It had happened before.

### "How Mad We Are!"

Pressed with mounting debts at the end of World War II, Prime Minister Clement Attlee's government had offered to sell any Royal Air Force airplane to any nation with the cash.

The British Air Ministry had reassured Attlee that it "did not worry about selling its best warplanes abroad." The technical prowess of British manufacturers was so great that



Attlee's decision soon had deadly consequences. Just 18 months after receiving their first shipment of Nene engines, Soviet technicians had produced and installed exact copies into the first MiG-15s, thus producing the Soviets' first world-class jet fighter. Six months later, the Soviets were producing whole squadrons of MiG-15s, powered by Soviet copies of the Nene. By 1950, the year the Korean War began, the MiG-15 fleet numbered in the hundreds, and Soviet factories produced over 200 more each month.

The MiGs soon came to dominate Korean skies. "When MiGs break through our fighter screen," the *New York Times* military analyst Hanson Baldwin told readers, "a B-29 [is] shot down or damaged nearly every time." In the official Air Force history *The United States Air Force in Korea, 1950-1953*, author Robert Futrell dourly concluded, "the Soviet fighter's performance rendered obsolete every U.S. plane in the Far East. The Russian fighter outclassed the [U.S. Air Force's piston-driven] Mustang, whose pilots had no hope for survival when attacked by a MiG except to keep turning inside, to hit the deck, and to head for home as fast as possible." The MiG bested every other propeller-driven U.S. fighter brought to battle in the war's first months, and it went on to outpace America's first-generation jets, the F-80 and F-84, as well. In level flight the MiG was fully 100 mph faster than the F-80C; recalls Futrell: "It could climb away from the old Shooting Star as if it were anchored in the sky."

Part of the success was due to Soviet talent: The engine copies the Soviets had made were "a very marked improvement of the [Nene] jet engine that was sold to the Russians several years ago," U.S. Air Force General Hoyt Van-

denberg admitted to a secret Senate hearing in 1951, adding that they were "superior to any jet engine we have today." Only the U.S. F-86 had any chance of matching the MiG in speed and maneuverability. Today, aviation historians continue to argue over which was better: the F-86 or the MiG-15. The former was faster in level flight, the latter better at high altitudes. The Soviet airplane employed a powerful cannon; the U.S. craft, six rapid-fire machine guns. Most historians agree that the MiG lacked an adequate gunsight.

Even so, Sabre pilots were almost invariably outnumbered. "I personally counted more than 120 MiGs high above me on one flight," recalls Robinson Risner, who bagged eight MiGs during his combat tour. "This was while we had no more than 75 F-86s for the whole of Korea."

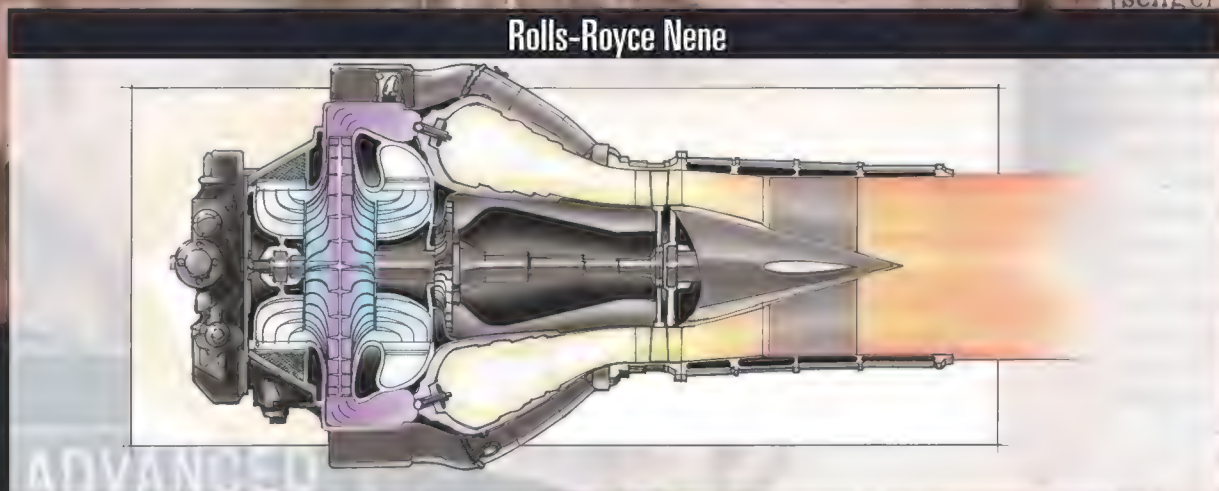
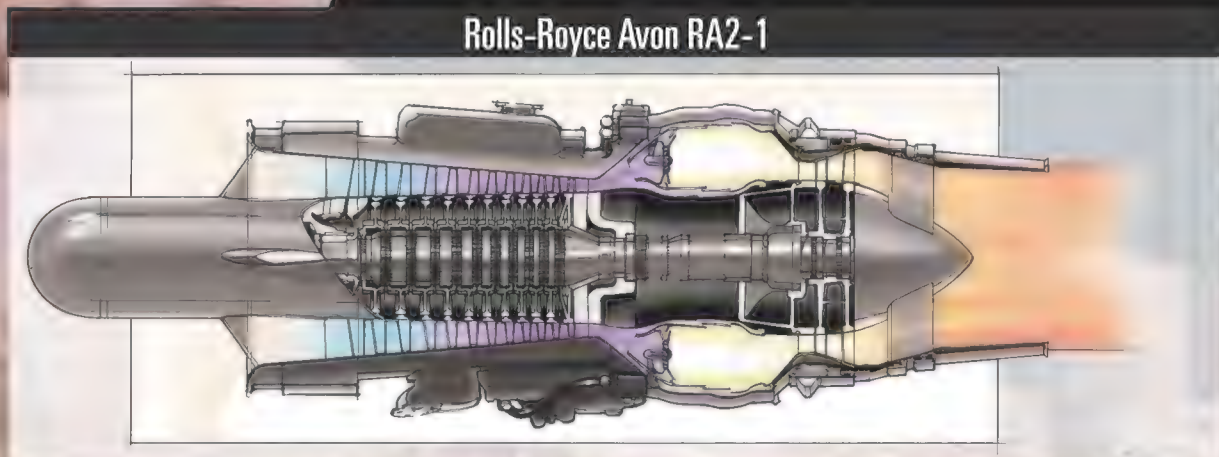
Not only were U.S. fliers outnumbered by MiGs, they were frequently outmatched as well, especially at high altitudes (see "To Snatch a Sabre," June/July 2003). The Soviet airplanes were designed for speed and for swooping down on enemy bomber formations from well above 40,000 feet. "We couldn't touch you if you wanted to get high enough, and you could outrun us," Risner told a Soviet ace nearly 30 years after the war. "But if we got you below 20,000 feet, we'd eat your lunch."

Comparisons are difficult to come to a conclusion about, as the two aircraft were designed for distinctly different purposes: the Soviet as a bomber-interceptor, the American as a dogfighter. "I could make ace in a day flying a MiG just by picking off stragglers trying to come and get me" at 50,000 feet, claims Colonel Stephen Bettinger, a Sabre pilot who did make ace during the war.

In the end, it may well have been better training and a



The Nene had a double-entry centrifugal compressor; the later Avon (photo) was designed for more efficient axial air flow.



LEFT: COURTESY BAE SYSTEMS; ILLUSTRATIONS: HARRY WHITVER

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stronger command that helped the U.S. pilots achieve a higher kill ratio.

One thing remains certain: The Soviet fighter would never have had a realistic chance of gaining air superiority over Korea had it not first gotten a British-built engine.

### The Allure of the Avon

The speed with which the Soviets had copied the U.S. B-29s and the British Nenes naturally made the U.S. military worry: If Comets were now to be sold to other nations, the aircraft's Avon engines might eventually end up in Soviet hands too, and be duplicated.

Nonetheless, the possibility did little to temper Britain's enthusiasm for marketing the Comet. "Provided the aircraft are not sold to a Communist country, we are simply not concerned who the buyer is," the Foreign Office's Philip de Zulueta told a colleague. British jets had an enormous lead over their closest rival—the first U.S. jetliners were not expected to carry passengers until 1957 at the earliest. No one in Britain wanted to give up that advantage without a fight.

Charged by Churchill with finding a solution to this delicate problem, a Cabinet committee "weighed the security risk against the country's economic advantage and need" and "concluded that safeguards could be imposed which would reduce the security risk sufficiently to warrant the sales of these engines or aircraft, thus enabling us to reap the economic advantages of our technical lead." The safeguards included five major points:

- No airplane powered by, or carrying, a Comet engine could ever fly to, or over, Communist-held territory.
- All scheduled maintenance work, for the engine's first 18 months of service, must be carried out by British technicians, and on British territory.
- All engine maintenance staff employed overseas must be screened for security.
- All spare engines to be sent abroad must be shipped in British vessels.
- Any spare engines held outside the United Kingdom must be maintained in a British territory, and can be flown to foreign territory only when essential. When housed in a foreign country, the engine must be contained in a building owned and supervised by the British.

Officials initially considered mandating that spare engines held overseas be chain-locked to the floor, the key held only by a British embassy official, but they concluded that this requirement was excessive.

But the safeguards weren't enough for Washington policymakers, who balked at placing U.S. national security in the hands of a BOAC or Air France. Airlines, by their nature, cared more about profits than precautions. U.S. diplomats declared that Britain had a duty to protect U.S. security, especially after the Nene transaction. President Dwight Eisenhower's aides buttressed their arguments by citing an obscure 1949 British-U.S. accord that was called the Burns-Templer Agreement; according to its terms, because Avon technology had been developed partly through U.S. assistance and cooperation, the United States deserved a say in whether it should be sold.

"It is virtually certain that the U.S. would not agree to our

planned exports of Comets to foreign countries," Sir Harold Alexander, the Ministry of Defence, warned Churchill. "Their agreement would be necessary before we could put these aircraft into service on our own British airlines!" Another diplomat railed: "To accept American ideas about security of advanced jet engines would cripple our aircraft industry."

The U.S. aircraft industry, on the other hand, could actually profit from the restrictions, providing firms such as Boeing and Douglas time to catch up to de Havilland. Neither U.S. company had yet even to fly a prototype jet air-



liner. In a brief moment of candor, John C. Elliott, a U.S. diplomat in charge of negotiating the Comet affair, chatting with the British ambassador, confided that his negotiators were "under pressure from their own aircraft industry" to restrict Britain's Comet sales.

The pressure wasn't enough. Churchill's cabinet unanimously rejected the idea of letting the United States restrict Comet sales. Anthony Eden, Britain's foreign secretary and future prime minister, explained: "Our economic needs differ from theirs [the Americans] and must be given full weight. We cannot afford to refrain from earning foreign currency, provided adequate security arrangements are made."

Still, the decision hadn't been easy. Britain worried that seeming uninterested in U.S. security could destroy Anglo-





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# A Century of Flight

One hundred years ago the Wright brothers took off at Kitty Hawk and changed the world forever. Though air travel has become a fact of life over the past century, our passion for flight has only propelled us to new heights, creating legends of pilots and icons of airplanes.

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## Wright 1903 Flyer

After building three successful gliders in three years, Wilbur and Orville Wright felt confident that they could construct the world's first powered machine capable of sustained, controlled flight. In 1903 they were ready to test their Flyer at Kitty Hawk, a spit of sand located on North Carolina's Outer Banks. On the morning of December 17, Orville lay in its cradle, which controlled the wingwarping mechanism. It was a logical design — he could just shift in the direction he wanted to turn. He grabbed the stick control for its forward elevator and took off down the launch rail. The Flyer kept rising and dipping until it hit the sand and skidded to a halt 120 feet from where it took off. Wilbur went next and flew an undulating 75 feet; then Orville flew it 200 feet. Wilbur next took over, and the machine crossed a whopping 852 feet. The machine weaved at first, then he got the hang of it and flew stable for the last half of the flight. Though the Flyer covered less than a quarter-mile in total, it was the first to prove controlled flight was possible.

## Ryan NYP Spirit of St. Louis

When Charles Lindbergh decided to become the first person to fly solo across the Atlantic in 1927, he chose a special Ryan monoplane for the attempt. He traveled from his St. Louis home to Ryan's San Diego factory to design the airplane himself. Based on the company's M-1 and M-2, Lindbergh's *Spirit* had a longer wing for greater range. It also had its huge tank in front because Lindbergh didn't want to be sandwiched between the Wright Whirlwind engine and a gas tank if he crashed. The tank obstructed his forward view, however, so he added a periscope to see ahead for takeoff. The rest of the time he flew by instruments, which took up every inch of the panel. The 130-mile-per-hour airplane was unstable, but Lindbergh preferred it: that's what kept him awake for the day and a half it took him to reach Paris from New York. He landed 33 and one-half hours after takeoff, in the midst of an exuberant crowd gathered at Le Bourget Field. News of his daring trip quickly circled the globe, and flying captured the public imagination. People not only worshiped Lucky Lindy, but they also wanted to learn how to fly.





# Flight



## *Piper J-3C-65 Cub*

The J-3 Cub began as the Taylor Cub in 1930, and the design was bought by William Piper not long after. Powered by a 50-horsepower Continental engine, the fabric-covered, high-wing Cub also sported conventional landing gear — two wheels up front and a small wheel beneath the tail — and two tandem seats inside the enclosed cabin. Cubs came in any color, as long as it was yellow. It was equipped with a minimum number of instruments, no radio, and just a stick and rudder. But it was a delight to fly. The Cub could take off from any surface — grass, concrete, even ice — so it quickly became a pilot trainer. During World War II, some Cubs flew as observation aircraft to spot enemy troop movements; a few even made it to Normandy on D-Day. Many others served as airborne ambulances in the days before helicopters. And some engineless Cubs were drafted to train pilots for troop-carrying gliders. Post-war saw the advent of the Super Cub, which had flaps. Pilots found them so friendly and easy to fly that the company eventually built nearly 20,000 Cubs for both civilian and military use.

## *Douglas DC-3*

The Douglas DC-3 was one of the most important aircraft in aviation history. The airplane first saw light as a 24-seat airliner back in 1935, and airlines were extremely pleased with the DC-3's rugged build. Pilots found its flying characteristics smooth and easy. They also found it could land on concrete fields as well as unimproved grass and gravel strips. With twin Pratt & Whitney Wasp engines of between 1,000 and 1,200 horsepower, the all-metal, low-wing, retractable-gear airplane had a maximum speed of 230 miles per hour. Due directly to the comfort and safety of the DC-3, airlines reported a 600% increase in passenger-miles. When World War II erupted and the military needed a troop transport quickly, it immediately turned to the DC-3. The airlines turned over their fleets to the Government, which christened the plane the C-47 Skytrain. Their pilots called them Gooneybirds, but with deep affection. Skytrains saw service in every theater of the war, from the steamy jungles of the Pacific, flying over the Hump (that is, the Himalayas), in Africa and in Europe. They were equipped to deliver cargo, carry paratroopers and tow gliders. Postwar, the airplane returned to the airlines. Hundreds still fly today.







## *Cessna Skyhawk SP Model 172*

As an editor of *Flying* once wrote, "If you can't fly a 172, you can't fly." The venerable Cessna first rolled off the assembly line in 1948 as the tail-dragging, four-seat Cessna 170. It flew well, but, like all tail-wheel-equipped airplanes, it had a tendency to ground-loop. In 1955 Cessna added a tricycle gear and christened it the 172 Skyhawk. It shot to popularity and soon replaced the Piper Cub as a pilot trainer. In fact, Skyhawks appeared on airport ramps around the globe — some 60,000 have taken to the air. While early versions had a sparse instrument panel and no rear window, the latest have a panel full of gauges, radios, and a rear window just like a car. It even comes with a fashionable swept-back tail. Thousands of pilots have spent their early hours in Skyhawks, flying circuits around runways and going on to fly solo for the first time. The 160-horsepower Avco-Lycoming engine propels it at a cruising speed of around 125 knots. It stalls at about 45 knots, but it's gentle and controllable throughout. In 1964 the U.S. Air Force bought the model, renamed it the T-41, and used the aircraft to put its fledgling pilots through primary flight school.

## *Boeing 747-400*

In the early 1960s the U.S. Air Force asked airline manufacturers to compete for a super-size jet transport. Boeing and Lockheed presented designs, and Lockheed won with the C-5A Galaxy. Undaunted, Boeing decided to go ahead with its enlarged version of the 707, which it called the 747. The company needed a customer to encourage other airlines to buy this jumbo jet, and Pan Am complied with an order for twenty-five 747s. The first Jumbo rolled out the doors in 1968. It weighed nearly 700,000 pounds, had a range of nearly 6,000 miles, and could fly more than 400 passengers at a maximum speed of around 600 miles per hour. Yet airports could still accommodate its 195-foot wing. It was capable of handling all those passengers due to its double-deck fuselage, a new feature for airliners. The earliest version had a piano bar that passengers could reach by climbing a circular staircase. As time flew by, however, later versions tossed out the piano in favor of more passenger seats. When Boeing introduced the 747-400, the company stretched the upper cabin, eliminated the flight engineer, and added computer screens and modernized flight controls for the pilots. The company also added vertical winglets to reduce drag. More than 30 years after its introduction, it's still the largest airliner in the world.





**H**ans Schlegel, a German experimental physicist, was very much aware of his national identity at the start of his first trip into space in 1993. Five of his countrymen had preceded him into orbit by the time he served as a payload specialist on shuttle mission STS-55, a 10-day flight on which the astronauts conducted 88 experiments within the shuttle's Space-lab science module. Another German payload specialist, Ulrich Walter, was on the same mission, and Schlegel and Walter sat beside each other during the launch. "But just before we got to orbit," Schlegel recalls with a laugh, "I put my right foot a little bit ahead, so I was the sixth German in space and he was the seventh."

Like others who have made the journey, though, Schlegel will never forget how his parochialism disappeared in the rush of emotion that hit him when he first saw the intensely blue Earth set against the blackness of space. "You

have that moment when you look out and say, 'Gosh, that's South Africa!' And after that comes about 40 minutes of Pacific Ocean—40 minutes! Then South America for 20 minutes, then nothing but the Atlantic Ocean for 10 minutes, and then you're back over South Africa. All in about an hour and a half. And then you realize we are in a small spaceship circling another spaceship. It's multinational [up] here too, with different races. It's just like that big ship down there—we're all in one boat."

The work itself was satisfying in a way Schlegel had never experienced.

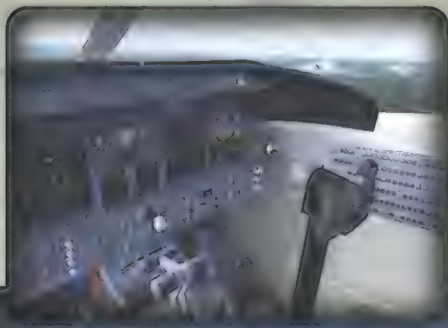
Patiently and methodically, he and his colleagues carried out all the required experiment protocols, the silence occasionally broken by a business-like comment from one of the other astronauts or from a Houston ground con-

*The European Space Agency has as many member nations as astronauts. Left to right: Umberto Guidoni of Italy on the STS-100 shuttle mission; Gerhard Thiele of Germany, Earthgazing, and with U.S. crewmate Janet Kavandi on STS-99; Claude Nicollier of Switzerland, outside on STS-103.*

ALL PHOTOS: NASA AND ESA







## Bombardier Learjet 45

There's an ungrammatical saying among aviation fanatics: "No Learjet hasn't been rolled." The sentence may be a double negative, but it's still correct: Bill Lear's line of small, docile jets is the closest thing in the civilian market to jet fighters (aside, of course, from the rare privately owned jet fighter). The latest Lear is the Bombardier Learjet 45, a lightweight business jet that can handle nine passengers in club seating and utter

comfort. Introduced in 1992, this Learjet is a two-pilot aircraft that weighs 35,000 pounds. In the 45's cockpit, Bombardier (which purchased Learjet in 1990) has equipped the flight crew with advanced instrumentation and a new diagnostic system that gives the pilots a heads-up on the jet's mechanical status. While the airplane is designed to be a business jet, it can also be configured for pilot training — a boon for airline pilot wannabes and military cargo-jet novices. This plane shoots skyward like a rocket, reaching nearly 50,000 feet in just 23 minutes. For long-range cruising, the pilots set the throttle at 482 miles per hour. That's almost as fast as any airliner, but you don't have to wait to board or deplane. Just like a jet fighter.



## Cessna Caravan C208 Amphibian

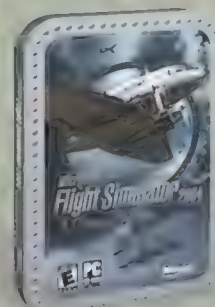
The Cessna Caravan came about largely because the venerable and rugged de Havilland Beaver had grown too long in the tooth. After all, de Havilland built its first Beaver in 1947. As more and more de Havillands retired, Cessna decided to jump into the market for a "utility" airplane, flying the first Caravan in 1984. But even a year before the Caravan was introduced, FedEx had placed its first order for 210 Caravans, all without windows and each equipped with all-weather instruments. For a single-pilot airplane the Caravan is one huge machine. Its wingspan is 52 feet, its length nearly 38 feet, and it's just above 14 feet high. And that's without floats. The airplane has a top speed of 212 miles per hour, a range of 1,117 miles, and it can get off the ground carrying 8,000 pounds. While its main job is carrying cargo — packages and such — it also transports people. And it does so in nearly every place on the planet, even on lakes and rivers. The militaries of several countries have bought a few each. And no one can beat it for bush flying.



All featured screen images can be found in Microsoft® Flight Simulator 2004: A Century of Flight game.

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troller. "Then you heard for the first time some laughter from ground control," Schlegel recalls, "and you talked to scientists there on the ground for a few minutes, and you realized there was joy in their voices! There was enthusiasm about the results! That is the most remarkable experience I had. It's something you can't get with any project on the ground."

And it's something he may not get again.

Despite the success of his mission, Schlegel has been on the ground ever since, waiting for another flight assignment. Even though 10 more Europeans have flown on the shuttle since Schlegel, available seats are getting harder to come by. The recent loss of the space shuttle *Columbia*, and continuing doubts as to whether the International Space Station will ever be completed, only add to the uncertainty over how many non-U.S. astronauts will fly, and when.

The European Space Agency hired its first three astronauts in the late 1970s, then chose another six from

22,000 applicants in 1992. Until recently, France and Germany also had their own small contingents of space travelers. (Schlegel flew as a representative of Germany, not ESA.) Then, in 1998, after announcing it would integrate all European astronauts into a single corps, ESA began another, smaller recruiting effort. Today, the number of European astronauts stands at 15—about one-third the number of Russian cosmonauts and only about 15 percent of the number in NASA's ranks.

An outsider might wonder why a continent with no space vehicle of its own, and no plans to develop one, would bother. True, at the time of the 1998 announcement ESA was already a partner in the International Space Station. But because Europe's contribution of funding and services to the project is relatively small (five percent), astronauts will have few flight opportunities, which are assigned in proportion to each partner's contribution. Even when the shuttle flies four times a year, one ESA astronaut would get to fly only every two or three years

or so. European astronauts can also buy rides on the Russian Soyuz vehicle, but those flights too have become less frequent.

To some, like Patrick Baudry, a former member of France's astronaut corps, the whole enterprise has become little more than a sham. "The European space program is nonexistent and null for manned spaceflight," Baudry says. "It's more political and bluff than a structured, solid program with a future." Former French research minister Claude Allegre has been even more disdainful. In 2000, he told science writer Pierre Kohler that France's astronauts "go into space for their own pleasure and go into orbit to get rich."

ESA's astronauts, of course, beg to differ. They say that Columbus, the research module their agency is building for the space station, will provide the "solid structure" Baudry finds lacking today. Scheduled for launch no earlier than 2005, Columbus is advertised as a platform for microgravity experiments that could improve life here on the ground. "When I speak to audiences, the question comes up whether we should put money into spaceflight or maybe instead into hospitals," says Reinhold Ewald, a German physicist and astronaut. "I say hospitals can be improved by making things [hospitals use] either





cheaper or better through development in space."

Columbus also is meant to evoke the pioneering spirit personified by its namesake. "Exploration is a deep part of European culture," says Claude Nicollier, a 59-year-old Swiss who, with four shuttle missions under his belt, is one of ESA's most experienced astronauts. But ESA's primary interest in sending humans into space always has been scientific. Nicollier, Ulf Merbold of Germany, and Wubbo Ockels of the Netherlands—ESA's first three astronauts, selected in the late 1970s to fly on Spacelab missions—were all scientists before signing up for spaceflight. "During the selection process they asked us questions about all different kinds of sciences," Nicollier recalls. "They wanted to know not only if we were really qualified in our own fields, but also if we had interests in other fields." It was not until 1992 that ESA hired pilots as astronauts; now almost half the corps have military aviation experience.

Another motive, not as easy to admit, is pride: Many Europeans would like a truly independent space program, instead of always having to hitch rides. But official backing for human spaceflight is weaker and more fragmented in Europe than it is in the United States. France's Allegre was not alone in his critical view of astronauts. Britain's Astronomer Royal, Sir Martin Rees, writing last year in the magazine *New Statesman*, called manned spaceflight "a rather jaded spectator

sport," and trashed the International Space Station as "neither practical nor inspiring."

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SPACE VEHICLE OF ITS OWN, AND NO PLANS

TO DEVELOP ONE, WOULD BOTHER.

Public support isn't what it used to be either. Byron Lichtenberg, a NASA mission specialist on Spacelab's 1983 maiden flight, recalls huge, adoring crowds greeting ESA's first three astronauts—Merbold, Ockels, and Nicollier—when they visited European cities during the early phases of their training. "Everywhere we'd go, they were the stars of the show," Lichtenberg says. Merbold outshone the others, since he was the only European who would actually fly on the mission (the other two served in support roles). "If you mentioned Ulf Merbold's name to anyone from Germany," Lichtenberg says, "you heard, 'Oh yeah, Ulf, he's our astronaut!'"

But if Merbold were to walk through downtown Cologne today, no one would recognize him, says fellow German astronaut and shuttle veteran (STS-99) Gerhard Thiele. "Not even with a name tag. Everybody in Europe knows who Neil Armstrong is," Thiele says, "but not everyone knows Ulf, and he's one of the most popular."

Media interest too has been fickle and nationalistic. Sweden's first and only astronaut, Christer Fuglesang,

drew attention from the Swedish press when his first flight assignment—on the now-delayed STS-116 mission—was announced last year. But no other European media expressed any interest, according to the NASA press office at Johnson Space Center. To be fair, spaceflight doesn't thrill the American public like it once did either. But its place in the country's cultural history and mythology is secure. In contrast, the ESA human spaceflight program has barely registered in the European collective consciousness. Not long ago a survey showed that only about one in 10 Europeans even knew of the agency's existence.

No matter, say ESA astronauts. They don't really care to be cultural heroes. "We bring a rational approach to human spaceflight," says Ewald. "Our approach is away from having to prove something, as on the Russian side, which wants to prove it's still a strong actor in space. And we are less concerned than the U.S. about how astronauts are perceived by the public."

Like many of his colleagues, Ewald, 46, speaks in earnest, subdued tones that belie a lifelong enthusiasm for space exploration. A science fiction fan as a child, he was awed by the Apollo moon missions. Ask ESA astronauts what awes them now and their answers don't convey much excitement. They dwell instead on the challenge of a difficult job, as if it might jinx their chances of flying to admit how much they really want it.

Those who have been up say it's worth the wait. After working as an astronaut for 14 years, Nicollier finally made it to space on the STS-46 shut-

*From left: Frank De Winne was a test pilot for the Belgian air force before joining ESA; the astronaut training center in Cologne; Claudie Haigneré (shown after returning from the space station in 2001) flew for France, then for Europe, and is married to former ESA chief astronaut Jean-Pierre Haigneré (not shown); the Columbus research module is Europe's main contribution to the station; Haigneré training with cosmonaut crewmates in Star City.*





the mission in 1992. He flew again the following year on STS-61, the first orbital service call to the Hubble Space Telescope. Even though he's been up twice more since, including on another Hubble repair mission in 1999, during which he became the first European to make a spacewalk from the shuttle, his first trip to the space telescope is still the most meaningful. "I am an astrophysicist, and as an astrophysicist-astronaut working on Hubble, it was an incredible privilege," he says. "There was a lot of pressure to succeed after the embarrassment of launching Hubble with a bad [mirror], and it was the very first time we started to do something we often do now—use a combination of spacewalking and robotics. It had never been done before, and we had to invent ways of stabilizing the crew member while he or she was working with power tools or manual tools. We also had to define the choreography and the rules of engagement, and even the wording that would be used." Training for all these first-time tasks, he recalls, "was so incredibly exciting." And when he returned to Hubble on another repair mission six years later, "it was like visiting an old friend."

**A**pproaching the European Astronaut Center in Cologne, you don't see the same kinds of spacecraft mockups and other oversized national trophies that you find adorning the grounds of NASA's Johnson Space Center in Houston. Nor will you see in the surrounding neighborhoods inflatable space shuttles or neon planets mounted on the roofs of fast food restaurants.

The EAC is a solitary building with all the personality of a warehouse, located in what looks like an industrial park but is in fact the campus of DLR, Germany's space agency. In front of the building, 15 flagpoles form a circle like a steel honor guard, each flying the colors of an ESA member nation—France, Germany, Italy, Sweden, Great Britain, Switzerland, Belgium, Spain, Holland, Portugal, Norway, Ireland, Denmark, Austria, and Finland. In the lobby a small scale model of the space station hangs from the ceiling. Similar models of Soyuz and Ariane rockets

stand almost directly beneath, with a model of space shuttle *Discovery* nearby. Hanging on another wall are photographs of every European chosen to serve as an astronaut—33 in all.

The EAC was built in the late 1980s, at a time when ESA, with France taking the lead, was planning to build its own mini-space shuttle, called *Hermes*. Crew training would have been at the EAC. In the early 1990s, though, ESA canceled *Hermes*, in part because it was proving too expensive. Instead, the agency decided to keep buying tickets to orbit from Russia and the United States.

astronauts are undergoing some form of training at Johnson, and the rest are either at Star City training with cosmonauts or handling managerial or technical duties at other ESA facilities in Europe. Hence the EAC's reputation as a bit of a white elephant.

"EAC? Right now it's not used very much," says Gérard Brachet, a former director general of CNES, the French space agency. "I've visited it several times, and the first thing you notice is how few astronauts are there." Astronauts come occasionally to train on the mockup of the Columbus module, but they don't stay long.

**"I'VE BEEN IN SHUTTLE CREWS WHERE WE**

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**THIS,' THEY LONG AGO HAD TO GET BEYOND IT."**

**—NASA ASTRONAUT MICHAEL FOALE**

New ESA astronauts receive only basic training at the EAC. For most of their spaceflight training, they go either to the Johnson center or to Star City, outside Moscow. According to Hans Bolender, director of the EAC's astronaut training division, the center teaches recruits "one year of fundamental knowledge of astronautics," plus some basic space history.

Recruits also learn "generic information on [ISS] systems and elements, along with basic information about space biology experiments and their objectives."

Eventually, the center will be the focus for training on the Columbus module and the Automated Transfer Vehicle, a large cargo carrier ESA is building for the space station. All station crews, even NASA astronauts and Russian cosmonauts, will come to Cologne to familiarize themselves with these two elements.

But until then, not much happens at the EAC. In fact, at the moment no astronauts are stationed there. Five ESA

*From left: Jean-Francois Clervoy (working the shuttle's robot arm during the STS-103 mission) and Claude Nicollier (to his right on Discovery's flight deck), have flown on three and four shuttle flights respectively, more than any other ESA astronauts. Sweden's Christer Fuglesang, meanwhile, is still waiting for his first flight. Claudie Haigneré and Reinhold Ewald (in helmet) and Roberto Vittori (right) train in a water tank in Moscow. The Russians flew the first German and French astronauts in the 1970s and 1980s, and still occasionally offer rides to ESA fliers—for a price.*



Some say the failure of the Hermes project, which robbed the EAC of its main purpose, was a blessing in disguise for ESA, because it helped the agency avoid a costly mistake. Keith Wright, who spent nearly two decades at ESA working as a systems and safety engineer on projects including Hermes and Columbus, says, "The big problem with Hermes was that it was really a political program on the French side. They wanted Frenchmen in space, Frenchmen landing on runways in France, this kind of thing. But they were going to put it on a launch vehicle that was not designed for that job—the Ariane 5 was not big enough. The [design of the] spaceplane got smaller and smaller and very expensive, and in the end proved impractical."

Critical to that learning process, says Wright, was Nicollier, who advised the project on how systems would have to operate from the crew's perspective. "The feedback we got from him when we were trying to design Hermes was absolutely invaluable," Wright says. "And we couldn't have gotten it without his experience." NASA astronauts

assume the same kind of advisory roles between spaceflights, but Russians are less likely to share information, say some ESA fliers who have worked in both programs.

"We had quite a big shock when we started training for the Mir missions," says Italian astronaut Paolo Nespoli, 46, a tall, strapping former parachute instructor and engineer. "We found that in Russia, knowledge is power—it's one of the things you can keep for yourself. And transfer of knowledge meant you lose an edge."

Nespoli—who as a kid dreamed of becoming an astronaut when he saw "men jumping up and down on the moon"—recalls his Italian army instructors showing up with armloads of charts, which they would distribute to the class. In Star City, he says, "the Russian instructor would come in with charts, hang them up, and use a pointer while discussing them for an hour. Then afterward he'd roll everything back up and go away. We'd ask, 'Can we have a handout of the charts?' And he'd say, 'No.' All you had were the notes

you had taken. And when Russian is not your native language, these long technical names are things you can barely spell out, much less remember." Nespoli managed to get through anyway.

British-born Mike Foale, a NASA astronaut who also has trained in Russia with cosmonauts, admires this "determination to do something hard" in his European colleagues. He sees the typical ESA flier as "a person who is absolutely willing to uproot his family or himself, and go and travel and live somewhere else to fly in space. At the same time, he's having to learn Russian as well as having learned English. I'm already impressed."

The five Europeans currently training at Johnson say that being team players comes naturally for people from interdependent countries who live in close proximity. "We're all used to working in a multicultural environment," says Fuglesang, of Sweden. Nespoli adds, "While it's true that most







*Cosmonauts Yuri Lonchakov and Sergei Zaletin and ESA's Frank De Winne (left to right) pose with spacesuits before visiting the space station (under construction, below left) last year. Pedro Duque (with STS-95 crewmate Steve Lindsay floating above him, center) was the first Spaniard in space. Roberto Vittori (with hat) and De Winne undergo wilderness survival training near the Black Sea in Russia.*

of the station is American, there is also an international character. And that means you have to make sure that whatever you do, whatever everybody does, you do it in a way that it's all understandable and compatible with everyone else." The compromise isn't all one way either, he says. The presence of ESA astronauts "makes the Americans think outside the box a little bit."

Charlie Precourt, a former NASA astronaut who is now the agency's deputy program manager for the space station, echoes Nespoli's opinion. Working alongside ESA astronauts "has really broadened the perspectives of American astronauts," he says. "And it's made us think less parochially about our program."

It also has helped buffer the occa-

sionally testy relationship between the station's two senior partners. "Russia is hard for everybody to deal with because it's full of Russians," says John Logsdon, director of the Space Policy Institute at George Washington University in Washington, D.C. "Their overall national culture and their human spaceflight culture are different than the West's. They're very hard bargainers, and not great at compromise."

The Russians, in turn, often look to the Europeans for help with NASA. "When they come out of negotiations with the Americans," says Ewald, "the first thing they ask is 'Can you explain what they mean?'"

"ESA is quite aware of its bridging role," says Logsdon, "and having the three main players working in a kind

of three-dimensional game is a healthy thing." Precourt concurs: "The Europeans have developed great understanding of the Russian system, and I find them acting as great go-betweens. They help facilitate the relationship."

The perception that Europe is third among the station's six partners (the others are Japan, Canada, and Brazil) has more to do with this vital bridging role and with Europeans' historic affinity with the United States and Russia than with actual numbers. Japan contributes one and a half times what Europe does to the station's costs and services. Yet ESA's profile is much higher than that of NASDA, the Japanese space agency.

Europeans like to think the quality of their space program may also be a





factor. "Our work and experiments on Spacelab were very successful," says Hans Schlegel. "If you compare [areas] where we have expertise, I think we're pretty close to the level of the Americans, and I think we can contribute a little more than the Russians." While that may sound boastful, there is some basis for the claim.

Wright, of the British Interplanetary Society, says the purpose of Spacelab was to bring Europe up to U.S. space-flight standards. The program ended up doing more than that, he believes: "In fact, it pushed [European] manufacturing technology so far that quite a lot of the station modules, particularly the logistics modules, are all being built in Italy now." In exchange for providing the Raffaello module—a van for delivering cargo to the space station—NASA gave some of its research time on the station to the Italians.

Other researchers, including Americans, are impressed by the experiments ESA-funded scientists have been developing for the space station. Mil-

lie Hughes-Fulford, who flew as a scientist-astronaut on a Spacelab mission in 1991 and now heads a cell biology laboratory at the University of California at San Francisco, has designed several shuttle experiments, including one that flew on *Columbia's* final flight. "The Europeans have done the best job in [building hardware for] cell biology," she says. "They're far and away the leaders."

It isn't just in the areas of science and engineering that ESA has earned respect. In Star City, some European astronauts have trained to fly the ascent and entry of the Soyuz in case the Russian commander for some reason can't. NASA astronaut Foale explains, "They're flying the left seat, not just [sitting] mid-deck [as they do] on the shuttle. When I go through classes there on the Russian left seat, I'm forever hearing stories about how well the European left-seater understands the Russian systems. In Russia, European astronauts are a big deal, and they're probably treated with a little more direct support and respect than in this mass of American astronauts."

On paper, ESA has big plans for its astronauts. In January of last year the agency unveiled the Aurora program, which will be conducted over the next 30 years. Wright describes Aurora as a "very, very long-term plan." The agenda calls for human as well as robotic exploration of Mars, the moon, and a number of asteroids. The vision is similar to one recently unveiled by the NASA Exploration Team (NEXT), but neither program has much funding or attention right now, and both are relegated to a vague future. Meanwhile, says Wright, "ESA is trying to build an experience base" in case the agency's astronauts are someday needed for

missions that go beyond Earth orbit.

Having crew members on *Columbia* or just flying in space regularly is therefore crucial to ESA's long-range plans. But several tall hurdles are in the way. First and most daunting is the scaling back of the space station to accommodate only three astronauts, which NASA did two years ago to control the project's runaway costs. The *Columbia* accident reduced the station crew to two people, but only as a temporary measure until the shuttles resume flying. As of today, NASA has no firm plans to increase the crew to the six or seven members that had been agreed on when ESA and the other international partners originally signed up. And until that happens, ESA's flight opportunities will be so limited that even 15 astronauts may be too many.

Mike Foale says he would have applied to ESA back in the 1980s when he was looking to become an astronaut, but by the time he felt he was qualified, the agency had already announced an indefinite hiring freeze. Fortunately, because he also had U.S. citizenship, he was able to join NASA's corps instead.

But he has great respect for his colleagues across the ocean. "They complain less," he says. "I've been in shuttle crews where we [NASA astronauts] are all grumbling about this or that. The ESA astronauts aren't saying a word. This whole business of 'I deserve this or that,' they long ago had to get beyond it and learn to say, 'Well, that isn't the way the world works. You're lucky enough to get what you get and should be happy with it.'"

Would he become an ESA astronaut today, given the chance? "I'm very glad to have had the NASA opportunity and wouldn't turn away from that," he replies with a laugh. "It's easier to be an astronaut for NASA. So much easier."

Among its other problems, ESA has had difficulty lately with its Ariane 5 rocket, which blew up after launch last December, stranding science projects like the ambitious Rosetta comet mission, due to leave Earth next year. ESA science managers talk about a crisis, and struggle to find the money to weather the delay. The agency's astronauts take it all in stride, and wait. ➔

"WHEN [THE RUSSIANS] COME OUT OF NEGOTIATIONS WITH

THE AMERICANS, THE FIRST THING THEY ASK IS,

'CAN YOU EXPLAIN WHAT THEY MEAN?' "

—ESA ASTRONAUT REINHOLD EWALD



# How Things Work:

# Ground Pro

by Damond Benningfield | Illustrations by John MacNeill

**For a pilot flying at 15,000 feet, nothing can spoil the day faster than a 16,000-foot mountain suddenly looming ahead.**

Whenever an airplane is functioning properly but nonetheless slams into terrain, either because it is off course or because the pilot has lost track of his position, the technical term is “controlled flight into terrain”—CFIT, pronounced “SEE-fit.” Around the world, about four flights succumb to CFIT each year. Investigators recently found CFIT to be a factor when a Fokker F-28 slammed into a cloud-covered mountaintop in Peru last January 9, killing all 47 people aboard.

The Federal Aviation Administration

cois of Honeywell Aerospace. “If you were going into very steep terrain, then you got a very short warning”—10 to 15 seconds or less. And GPWS cockpit displays were crude; their sole visual warnings were lights. Even with GPWS, the pilot of that F-28 still flew his airplane into a mountain.

Today the FAA is banking on an improved technology: the Terrain Awareness and Warning System. The agency requires that in the United States, all new airliners (and by 2005, most older ones) be equipped TAWS. The new technology has the ability to look not just down but also

ahead, so that the crew can get



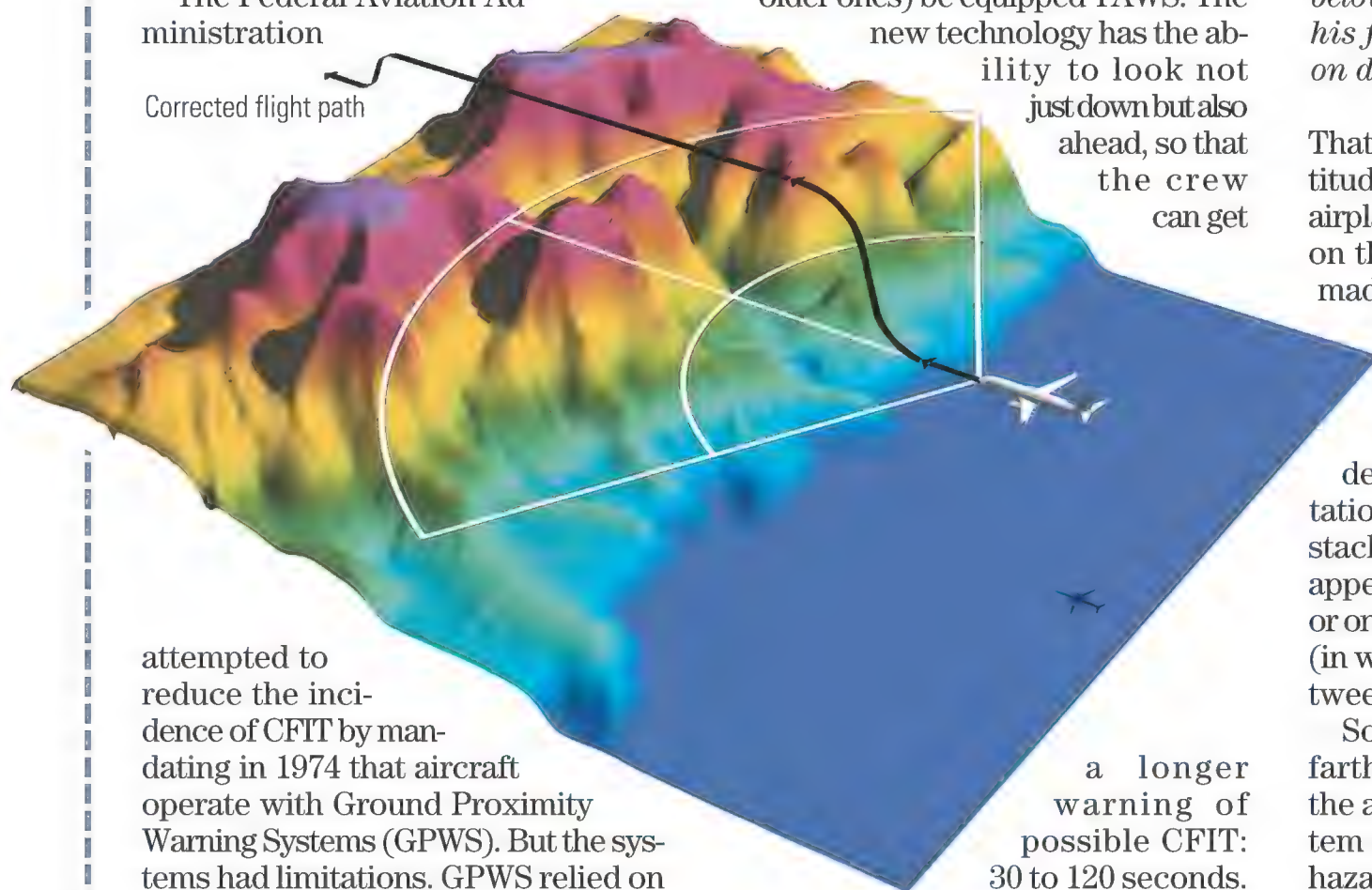
*Honeywell named its TAWS “EGPWS,” for “enhanced GPWS.” Above, an EGPWS cockpit display shows something in red—above the aircraft’s altitude. The schematic below illustrates a pilot altering his flight path (black line) based on dangerous altitude data.*

That data, along with the aircraft’s altitude, are fed into a computer in the airplane. The computer has a database on the world’s natural terrain, man-made obstacles, and runways.

When the airplane’s position and flight path are superimposed on the database of the relevant area, the results are rendered as detailed visual representations of significant terrain and obstacles around the craft. The images appear either on a dedicated monitor or on the aircraft’s weather radar screen (in which case the pilot can toggle between weather and terrain displays).

Some manufacturers’ systems go farther, analyzing the flight plan in the aircraft’s flight management system computer and plotting potential hazards along the entire route.

Today’s TAWS monitors show terrain below the aircraft’s altitude as green or black, terrain near the aircraft’s altitude as yellow, and mountains or other terrain well above the aircraft’s altitude as red. When the



attempted to reduce the incidence of CFIT by mandating in 1974 that aircraft operate with Ground Proximity Warning Systems (GPWS). But the systems had limitations. GPWS relied on the airplane’s radio altimeter, which determines the aircraft’s altitude by bouncing a radar signal off the ground and measuring the duration of the signal’s round trip. “The sensor was looking straight down,” says Greg Fran-

a longer warning of possible CFIT: 30 to 120 seconds.

And for visual warnings, TAWS gives detailed pictures of significant terrain.

TAWS uses the Global Positioning System to determine the aircraft’s position, ground speed, and ground track.



# Proximity Warnings

aircraft is descending, the colors represent distances above or below its projected glideslope. When the aircraft is a minute or so from flying into the ground, the TAWS gives both visual and aural warnings.

TAWS uses the same warning modes that were used in the older GPWS:

- Mode 1 warns of an excessive descent rate during landing or whenever the aircraft is close to the ground. The initial warning is the phrase "Sink rate"; if the problem isn't corrected, a "Pull up" warning is issued.

- If the aircraft is flying into the slope of a mountain or across other steep features and the ground clearance is rapidly decreasing, mode 2 issues an aural "Terrain" warning, followed by "Pull up."

- Mode 3 helps pilots maintain a positive climb rate after takeoff; once the aircraft reaches 1,000 feet, the system sounds a "Don't sink" warning if altitude begins to descend.

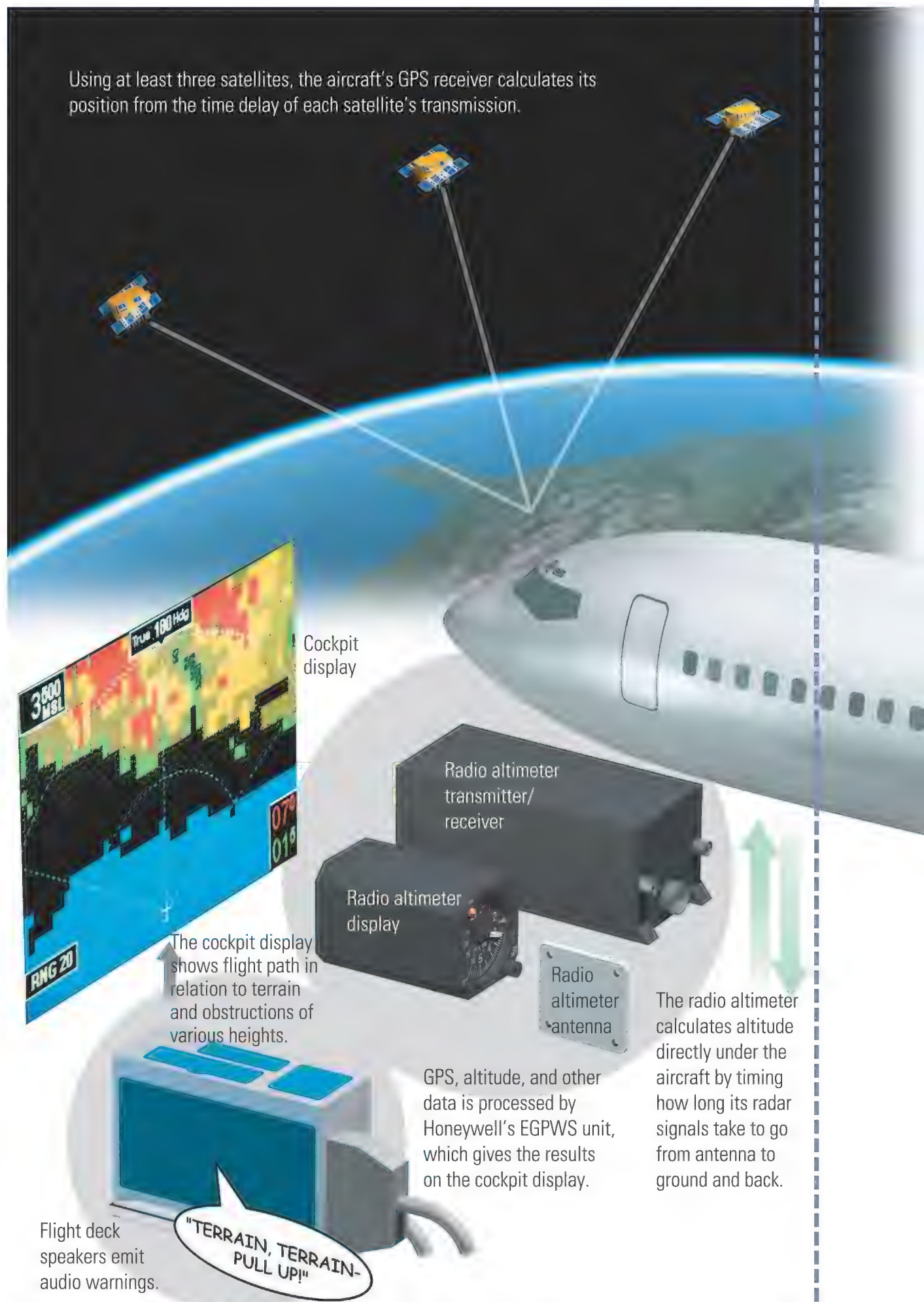
- Mode 4 warns if landing gear or flaps are not properly configured for landing, and if the terrain clearance is inadequate during final descent.

- When the crew is making an instrument landing system—ILS—approach, mode 5 announces "Glide slope" if the aircraft has deviated below a safe flight path to the runway.

Another operating mode calls out altitudes during descent, and the last warns of significant wind shear.

Today, 18,000 commercial, military, business, and general aviation aircraft have TAWS. Jim Burin, director of technical programs at the Flight Safety Foundation, says the F-28 that crashed in Peru and two other aircraft victimized by CFIT this year—a 737 in Brazil and an RJ100 in Turkey—all had the older GPWS systems, not the newer TAWS.

As TAWS comes to predominate in coming years, aircraft may have an easier time staying in the skies—and away from unexpected mountain peaks.







FLY TILL YOU DIE—WORDS THE HMONG AIR FORCE LIVED BY.

# VANG'S WAR

by Roger Warner





hroughout his childhood in Laos, he lived in a thatched hut with a dirt floor, outside the Hmong village of Muong Ngat, about 10 miles from the Vietnamese border. He never saw cars or trucks, but he did see his first airplanes high overhead as a boy, in 1953 and 1954. Some days he saw hundreds

of them, as the French and their U.S. allies flew supplies to a besieged French army garrison in the Dienbienphu Valley. But to a Hmong child like Vang Bee, the things he saw in the waning days of French colonial control over Indochina seemed to belong to another world.

After the fall of Dienbienphu, the French left Indochina, and a 1954 agreement partitioned it along political lines into North and South Vietnam. It wasn't long before the United States began to fill the regional power vacuum. That's when Vang Bee first saw an aircraft up close—a U.S. Sikorsky H-34 helicopter about the size of a house,

he recalls. His entire village watched in fear as it descended slowly and landed noisily in a cloud of dust. When they saw men emerging from the beast, the villagers relaxed. Not long after that, small fixed-wing air-

planes became a common sight.

By 1960 a civil war had broken out in Laos, and nations on both sides of the cold war sent support to the factions they favored. The Chinese, Soviets, and North Vietnamese communists backed the Pathet Lao; the Hmong were among several groups opposing the North Vietnamese. To counter the communists in northeast Laos, operatives of the U.S. Central Intelligence Agency and their allies in the government of Thailand contacted the highest-ranking Hmong officer in the Laotian army:

Vang Pao. To support this charismatic warrior, the CIA and the Thais sent in the Police Aerial Reinforcement Unit, or PARU, a Thai special-operations force whose officers had been through U.S. Army Ranger training. The PARU wore uniforms without insignias, spoke the Lao language, and blended in as if they were native Laotians.

A three-way alliance arose: Vang Pao recruited and led a Hmong guerrilla force that would grow to a 30,000-man multi-ethnic irregular army. The PARU provided trainers, radio operators, and field advisors for local Hmong commanders. The CIA provided money, food, surplus World War II-era weapons, a few dozen officers, and transportation in the form of Air America, a contract airline the agency secretly owned.

Early in this proxy war, the people of Vang Bee's village moved several times to escape North Vietnamese attacks. U.S. aircraft relocated tribespeople and dropped rice and supplies. According to Vang Bee, the elders appreciated the flights, which saved them long treks on foot, but soon came to take them for granted. For ambitious young people like him, however, aviation opened a world of opportunities and ideas. Now a U.S. resident, he recalls thinking: "Why the people can make the airplane fly in the air? A piece of metal, they made like a house, they put the engine in it. The airplane come from the technology. A lot of young Laotian people, they want to work close to the situation like that. I said, 'I want to know how to fly. I want to know.'"

In 1965, Vang Bee and his family moved to Long Tieng, Vang Pao's headquarters, southwest of Laos' Plain of Jars, named for the large and mysterious ancient stone vessels found there. By this time Vang Bee was a square-jawed young man serving in the new alliance's army. He was assigned to work as an announcer at a radio station, broadcasting news to the many ethnic groups in the north, but he did not like the job much, partly because the pay was low. When word went out that there were slots available for a dozen literate Hmong to take pilot training, Vang Bee was ready to apply, but his boss told him he was needed at the radio station and would just have to wait.



BILL LAIR/PARU COLLECTION

*Vang Bee (above left) flew combat missions from the CIA's Long Tieng, Laos air base (left). All Hmong pilots trained in light single-engine civilian aircraft (above).*





BILL LAIR/PARU COLLECTION

Vang Pao (wearing two-star insignia) and CIA officer Bill Lair (center) engineered the training program to limit the presence of U.S. troops in Asia (above).



COURTESY VANG BEE

The idea to train Hmong tribesman to fly—to yank them out of the Stone Age and plunge them into the 20th century—originated with a CIA paramilitary officer named Bill Lair, the founder of the Thai PARU and the day-to-day leader of the CIA's hill tribe operation in Laos. Lair believed that when it came

to the wars in Southeast Asia, the United States should provide training and modest assistance, but beyond that, should stick to a supporting role. He believed that the fewer Americans in Asia, the more self-reliant the local people would become. This was not the prevailing view in the U.S. government, which had already started sending troops to support South Vietnam and warplanes throughout the region, including the skies over Laos. Lair, who had parachute training and worked with pilots every day, was determined to train indigenous Asians in as many forms of warfare as he could and equip them to fight. In 1965 he visited a CIA supply depot on Okinawa and spotted a couple of dusty Piper Cubs in a warehouse. Lair arranged for the airplanes to be shipped to his base in Udorn Thani, Thailand. And then, without notifying his CIA superiors, he opened a flight school, complete with an English language course, for a dozen newly recruited smart young Hmong. The students stayed in a safe house on the edge of a grassy airstrip to the west of the town of Nong Khai, near the Mekong river. The flight instructor was Lair's PARU pilot.

By 1966 the first tribesmen were soloing in the Cubs. At the same time, a U.S. Air Force program at Udorn Thani was training Laotian military pilots in North American T-28D Trojans. The program, known as Water Pump, had specially selected U.S. personnel from a U.S. Air Force Air Commando



**IT WAS LAIR'S DEEPLY HELD BELIEF THAT**

**THE UNITED STATES SHOULD PROVIDE TRAINING AND MODEST ASSISTANCE TO HELP LOCAL ASIANS FIGHT THEIR OWN WARS BUT OTHERWISE STICK TO A SUPPORTING ROLE. HE BELIEVED THAT THE FEWER AMERICANS IN SOUTHEAST ASIA THE BETTER.**

Vang Bee flew the North American T-28D Trojan (above), the workhorse of the Laos conflict. The Water Pump program brought U.S. Air Force trainers to Udorn Thani, Thailand, (right). Air bases and villages in Laos (far right) were shared by the CIA, Hmong guerrillas, and the Thai PARU, a special police unit.

JOHN KOREN





unit at Hurlburt Field, Florida.

In some ways the T-28 was better suited than jets to supporting ground troops in combat in Southeast Asia: The Trojan could fly low and slow, maneuver through valleys, and loiter over targets. Just under 30 feet long and about 40 feet in wingspan, the airplane had been developed as a two-seat trainer after World War II. With huge flaps, tricycle landing gear, and a nine-cylinder, 1,425-horsepower Wright Cyclone engine, the T-28 was practical and versatile. But the official Laotian military, which was dominated by Lao lowlanders who had long disliked hill tribes like the Hmong, opposed allowing the Hmong into the T-28 program, and some Americans opposed the idea too. Teaching Iron Age tribesmen to become combat pilots was absurd, they said.

At Lair's request, the two most promising Hmong from the Piper Cub flight school were promoted to the T-28 program. After they completed their training, one of them died on his second combat flight when he flew into a cloud and hit a mountain. The other, named Ly Lue, had been the star of his Water Pump class. Undaunted by the combination of mountains and monsoon weather, Ly Lue flew his T-28 to Long Tieng. The dirt strip there sat in a bowl 3,000 feet above sea level, with a couple of steep karst outcroppings at one end of the runway and clouds and fog obscuring the mountain ridges during the rainy season. Once in Long Tieng, Ly Lue loaded his T-28 with 500-pound

*A Sikorsky UH-34 like this one, here training Laotians in use of a rescue hoist, was the first aircraft the young Vang Bee ever saw. Combat training for Hmong pilots included classes in rescue and survival fundamentals, such as the session below, teaching the use of an Mk13 day/night flare to mark the pilot's location for rescuers.*



JOHN KOREN (2)



bombs and dared his wingman, a lowland Lao lieutenant named Houmpheng Insixiengmay, to follow. The two airplanes took off, barely clearing the ridgelines. The brief golden age of the Hmong pilots had begun.

When the next wave of tribesmen were sent to Thailand for flight training, Vang Bee finally got his chance. Meanwhile, Ly Lue, in constant demand by ground commanders, was becoming a hero to his people. A CIA case officer, known as "Linus," with the tribal program remembers, "The Hmong loved to have aircraft working around them. But when a Hmong T-28 arrived on the scene, the excitement was electric. Those T-28 pilots did more to raise the fighting morale of the Hmong than all of the other factors combined. We could have American fast movers [jets] working around our positions and there were oohs and aahs, but when a couple of Hmong T-28s showed up on the scene, the Hmong ground-pounders could hardly contain themselves."

Like many of the tribal pilots who followed him, Ly Lue became exceptionally skilled at delivering ordnance.

He flew missions every day, and he dropped his bombs from treetop level, a practice that, while increasing his accuracy, allowed the underside of his airplane to be damaged by shrapnel from his own bombs. Legends of his feats, some unlikely, abounded. One story says that a North Vietnamese PT-76 tank once drove onto open ground on the Plain of Jars and that Ly Lue dropped a single bomb through the tank's open turret.

Most sorties from Long Tieng took an hour or less, and then Ly Lue would land at Long Tieng, re-arm, and go up again. Other pilots averaged three to five short missions a day, but Ly Lue flew five to eight, and occasionally 10.

It was a rate that couldn't be sustained. On July 11, 1969, with 720 missions in his logbook, Ly Lue was working a target at low altitude when a 12.7-mm anti-aircraft gun stayed on him all the way into the ground. During the funeral ceremony at Long Tieng, Vang Pao wept and U.S. officers paid respect to the pilot many considered the best in Southeast Asia. A new unofficial motto for the Hmong pilots began to circulate: Fly until you die.

In Udorn Thani, meanwhile, Vang Bee was learning the principles of aviation in the classroom. (Years later, he provides a succinct summary of what he learned about the creation of lift: "The wind heavier than the airplane.")





The U.S. instructors with the Water Pump program were never quite sure how aeronautical science blended with spiritual beliefs in their students' minds. The call sign for all the Laotian T-28 pilots, ethnic Lao as well as Hmong, was "Chaophakhao," meaning Lord White Buddha, a reference to a mystical sect of monks who wore white rather than the traditional saffron or brown robes. At his graduation, the Thai instructor pilots followed Buddhist tradition and doused Vang Bee with a pail of water to cleanse his soul. Back in Long Tieng, his parents followed Hmong religious traditions, lighting incense and praying to the spirits for his safety every morning when he left the house.

Vang Bee began flying out of Long Tieng in the dry season toward the end of 1970, after the Hmong had captured the Plain of Jars, the largest piece of non-mountainous real estate for miles around. In the rainy season the communists took the Plain of Jars back, and in the following dry season the Hmong would retake it. As a wingman, Vang Bee

armed his T-28 with whatever ordnance his flight leader thought was needed: 500-pound bombs for enemy bunkers; bombs with fuze extenders to create air bursts near troops in the open, napalm for deep bunkers or caves, white-phosphorous marking rockets, and .50-caliber machine gun ammunition.

After his first few hundred missions, he helped develop new tactics, such as using two-airplane teams for taking out enemy machine gun positions. Coordinating by radio, he and another pilot would come in from opposite directions, the first marking the site with rockets, the second hitting it seconds later with bombs. The teams flew during daylight hours, with little or no navigation equipment.

At night Vang Bee lived well by Hmong standards. His official salary, plus a dollar-a-

mission bonus from the CIA, plus unofficial payments from Vang Pao, added up to about \$200 a month, and that, along with the status that came with being a pilot, made him a catch to the women of his tribe. "The life of the fighter pilot very good for the single

man," he recalls with a laugh. "More money, eat enough, play enough, die no matter."

Some Hmong tribesmen flew with U.S. forward air controllers in unarmed Cessna O-1 spotter airplanes, serving as observers—"backseaters"—or as liaisons and translators. The FACs, known as Ravens because of their radio call sign, coordinated with a U.S. airborne command center and directed tactical strikes flown by U.S. jets based in Thailand and on aircraft carriers (see "Ravens of Long Tieng," Oct./Nov. 1998). By this point in the war, the North Vietnamese had abandoned guerrilla tactics and instead were installing large, fixed troop concentrations in Laos. The U.S. Air Force bombed the troops with B-52s. If the giant bombers were at one end of the Vietnam War air-power spectrum, the Hmong air force of six to 10 little T-28s was at the other. The Hmong pilots flew local missions under the direct command of Vang Pao, who often radioed orders to his pilots from an unarmed aircraft high above the battlefield. The T-28s, it was said, were Vang Pao's artillery.

But the North Vietnamese had real artillery to use in Laos, along with two army divisions. As dusk fell on December 31, 1971, North Vietnamese troops opened up on Vang Pao's positions with a tremendous barrage around the Plain of Jars and followed it up with assaults by waves of ground troops.

The shells came from Soviet-made 130-mm long-range artillery, and they caught the Hmong-Thai-U.S. alliance by surprise. After the North Vietnamese captured the Plain of Jars yet again, they began an artillery assault on Long Tieng. The T-28s were evacuated, and although they eventually returned, the mainte-

*Partners: Cessna O-1 Bird Dogs used smoke rockets to mark targets for the two-seat North American T-28s.*



*Hmong hero Ly Lue (left) with U.S. Air Force mechanic George Moses.*

KARL POLIFKA COLLECTION



PHOTOGRAPHER UNKNOWN





BILL LAIR/PARU COLLECTION

*T-28s honor Ly Lue, inspiration for the motto "Fly until you die."*

nance facilities that serviced them were permanently withdrawn to safer territory. After that, Long Tieng lost its importance as a base. AC-47 gunships, B-52s, and other formidable aircraft kept the air war going, but Hmong morale sank. The tribesmen didn't feel in charge of their own war anymore.

Vang Bee says he and the other Hmong pilots knew the war was lost when President Richard Nixon visited China in 1972. The fighting in Laos dragged on, though, and when a Hmong T-28 flight leader was shot down and killed, Vang Bee replaced him. Fly until you die. The signing of the Paris Peace Accords by the United States and both North and South Vietnam in January 1973 resulted in a cease-fire, and the U.S. Air Force stopped flying combat missions. Local skirmishing continued, though, and during one engagement, Vang Bee was shot down near the North Vietnamese border, not far from the village where he had been born. Unhurt, he was picked up by an Air America helicopter. After that, he did most of his flying at the controls of Vang Pao's personal aircraft, a twin-engine Beech Baron. By then, 36 tribesmen had gone through the T-28 program, and about half had survived. They even began to diversify, a few becoming C-47 co-pilots, a few others copiloting H-34 helicopters.

In May 1975, after South Vietnam and Cambodia fell, it was Laos' turn.

An evacuation of Long Tieng began, with thousands of tribespeople gathering on the runway in hopes of a ride to Thailand—the last pro-Western country in Southeast Asia. An Air America C-130 helped in the evacuation, and Vang Bee made five round trips in the six-seat Beech Baron; on one of them, Vang Pao's daughter gave birth in the cabin as the flight crossed the Mekong River. All the tribal pilots who survived to the end of the war made it to Thailand, and most of them subsequently immigrated to the United States.

The Americans who had known the Hmong pilots believed that the T-28 program had succeeded, even though the covert war as a whole had not. The Hmong, they say, would have done even better if they had had more education to help them coordinate with U.S. pilots and better understand instrument navigation. But they still performed far beyond expectations. Their dedication was, according to former Raven Karl Polifka, "unsurpassed by any combat pilot anywhere." He adds, "They seemed to have no fear, although I do think they had a vision of early mortality." Another Raven, Darrel Cavanaugh, says, "In close, they were damned accurate. They liked to get down there and mix it up with the bad guys." Bill Lair, long retired from the CIA, remembers, "I never saw any better bombing runs in my life." He still believes that the methods used to train the Hmong to fly would work anywhere in the world. Tribal people, says Lair, "can do amazing things, if they are motivated and given the chance."

Vang Bee, now living in North Carolina, is more ambivalent. He wanted to win the war and would have liked to see the U.S. extend its support. He also lost many of his best friends and believes he is lucky to have survived the war without any serious wounds. By his own reckoning, he flew about 1,000 combat missions and made another 400-odd flights in the unarmed

**AIR AMERICA  
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HELPED IN  
THE EVACUATION, AND  
VANG BEE MADE FIVE  
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BEECH BARON; ON ONE OF  
THEM, VANG PAO'S DAUGHTER  
GAVE BIRTH IN THE CABIN AS  
HE WAS CROSSING THE  
MEKONG RIVER.**

Beech Baron. He didn't keep a flight log, but all the available evidence suggests that his numbers are in the ballpark. Two other Hmong pilots who survived the war and at least two Lao pilots make equally plausible claims of having flown more than 1,000 combat missions in T-28s.

The surviving dozen-plus tribal pilots are scattered throughout the United States. None still fly, though they have inspired a few Hmong of the younger generation to take up aviation. Hmong communities such as those in Minnesota, California, and Wisconsin share information through a Web site ([www.hmongnet.org](http://www.hmongnet.org)), and a foundation named for Vang Pao has been established.

Vang Bee now calls himself Bee Vang, following the Western tradition of putting clan name last and given name first. One of his sons is a pre-med college student, and another plans to become a computer

engineer. Bee Vang has worked as a factory machine operator. He drives the family minivan, and he has occasionally flown as an airline passenger. That's as close as he gets to the aircraft that fascinated him as a young man in Laos—the machines that changed his life and, for better and worse, the fate of his people. ➤



ROGER WARNER

*Today, Bee Vang (né Vang Bee) lives in North Carolina.*



# Resto

## Yellow 10 | Focke-Wulf 190D-13 Dora

Some airplanes just look meaner than others, and *Yellow 10*, an ultra-rare German Focke-Wulf 190D-13 fighter, is one of them. With an elongated snout housing a massive inverted V-12 engine, three 20-mm cannon, and perfect knife-like proportions, the “butcher bird,” as the Luftwaffe nicknamed it, has always looked as if it would cheerfully go for the throat of any of the other airplanes in its Arizona hangar.

During World War II, D-series 190s—called Doras—could outclimb and outrun anything the Allies put into the air, thanks to a Junkers Jumo 213 E piston engine capable of churning out 2,200 horsepower. (The P-51D Mustang’s Merlin V-12, by comparison, could muster only 1,700 hp.) Doras also featured an almost unfathomably complex mechanical “brain box” which allowed their pilots to concern themselves with only a single power lever while their Allied counterparts had to manage separate propeller, mixture, and throttle controls.

For more than two decades, visitors to the Champlin Fighter Museum in Mesa, Arizona, gawked at the dapple-gray Dora without ever realizing that the impressive showpiece was actually a gigantic jumble of mismatched parts. Those in the know had always suspected there was something wrong with *Yellow 10* (the name refers to the yellow Luftwaffe squadron number stenciled on its side): The ammo chutes in its wings didn’t line up with the armament, and no one could ever quite manage to get the ailerons connected to the control stick in a logical way.

Academics speculated—but could never prove—that the U.S. Air Force was to blame. Immediately after the war, *Yellow 10* and a differently armed variant were brought Stateside for testing, and it’s thought that when the fighters were crated up in the late 1940s for sale on the surplus market, their wings were accidentally switched.

The effort to correct the mismatch gained impetus two years ago, when museum owner Doug Champlin acquired the first of three demilitarized cannon to install in his Dora. “That was when we decided we



*In 2001, with the wrong wings.*

either needed to make this wing work, or we needed to switch it,” remembers resident museum restorer David Goss.

After years of conversations, the Arizona team finally convinced officials at the U.S. Air Force Museum at Wright-Patterson Air Force Base in Ohio—home of the other Dora, an Fw 190D-9 on long-term loan from the Smithsonian—to swap wings with them. When the wings arrived, they fit *Yellow 10* perfectly, solving the mystery of the flight control mismatches. In order for D-13s to accommodate a newly included cannon that fired through the engine and out the fighter’s signature holed spinner (earlier versions of the Fw 190 had a machine gun), German engineers were forced to route aileron

BELOW: GOSSHAWK UNLIMITED PHOTO/ALAN E. GRUENING



*Above: F. Lynn Davis fabricates a gun bay door, based upon the armament compartment of the Smithsonian’s Fw 190D-9. Right: Restorer David Goss stands before Yellow 10 as his daughter Lindsey (seated), Robert Defazio (far left), and Davis recondition the fighter.*



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# ration

control tubes further aft in the wings.

The wing switch also helped shed light on Focke-Wulf's construction techniques. When the new wing was flayed open as part of *Yellow 10*'s current restoration, Goss and his crew were treated to the sound of dozens of shims—slivers of metal jammed in the structure to tighten a shoddy fit—cascading loose. Upon further examination, they also discovered hints of an odd process that may have been used to shear a stringer—a thin aluminum spar that runs along the top of the wing—from its metal stock. It's apparent that someone bent the metal back and forth until it broke off, rather than go to the trouble of making a clean cut. The grim explanation: *Yellow 10* was largely the handiwork of slaves upon whom German industry increasingly relied as the war dragged on. Seen in this light, the sloppiness takes on significance; maybe snapping off the metal was as much an act of defiance as of expediency.

Goss and Champlin feel all of this history must be preserved. Says Goss: "In 100 years, if someone decides to go looking inside this airplane, we want them to understand how things were done in Germany."

To that end, a good deal of Goss and Champlin's energies have gone into undoing the airplane's first restoration, which Champlin commissioned shortly after he acquired the Dora in 1972. Although that effort, done with advice from the fighter's designer, Kurt Tank, arrested the airplane's deterioration, it also stripped away much of its history.

"This time around, I said, 'Let's do this thing right,'" says Champlin. That's meant fabricating entire assemblies, such as ammo chutes and access covers for the cannon, from scratch. It has also meant replacing non-metric rivets and non-period switches and circuit breakers installed during the first restoration with originals or faithful reproductions. Champlin even paid a French company \$7,000 for custom-made metric rivets for the wings. "For that amount, you could normally expect to buy enough for an entire plane,"

Goss says. The team has also reinstalled the shims in the wing, but has chosen to smooth the edges of other roughly cut metal parts as a safety precaution for those who may work on *Yellow 10* in the future.

While Goss steers the restoration, Champlin spends much of his time tracking down radios, instruments, and other bits of Dora minutiae. The task, he says, has been made easier by the Internet and by warbird parts discovered in the former East Germany—resources unavailable in the 1970s.

Goss and Champlin expect to be finished with the airplane early next year. Although the fighter will be perfectly flyable, Champlin says that as long as he owns it, *Yellow 10* will remain earthbound. "It's just too rare," he says. "We'll start it up and taxi it, but that's all we're gonna do. It'd just be criminal to fly it."

—Howard Stansfield



Left: With the proper wings attached, *Yellow 10* reveals its mighty powerplant. Fw 190 designer Kurt Tank urged Doug Champlin to race it at Reno. Above: The *Dora* takes in a sunset at Goss' hangar.

LEFT: GOSSHAWK UNLIMITED PHOTO/ALAN E. GRUENING; BELOW: ©2003 DANCOCOGAN.COM





The floor of the arrivals lounge at the former Kai Tak airport displays a sign that reads “No Waiting,” but a dozen people still loiter. Not to greet passengers—the last one landed five years ago—but for the guard at the Kowloon East Job Training Centre to call the next applicant. Nearby, the counters that once faced a crush of impatient travelers checking in for Cathay Pacific flights now serve the Kai Tak Bowling Club, while downstairs, car buyers kick tires in a showroom converted from a baggage claim.

Vacationers and business travelers now fly from the new Chek Lap Kok International—which opened in 1998 and is 45 minutes away and nine times larger than Kai Tak.

Near the golf enthusiasts who tee off on a driving range upon the abandoned concrete of Runway 13 and the shoppers strolling through the open-air rummage sales are the stubborn members of the Hong Kong Aviation Club, still in place in their Nissen hut despite the changing fortunes of Kai Tak. The club goes back 80 years; it may have lost an airport but not the passion to fly. Because Chek Lap Kok is closed to most private pilots, the club now operates its six Cessnas and an aerobatic Slingsby Firefly from nearby Shek Kong military airfield, but only on weekends, and always subject to the goodwill of the People’s Liberation Army. One or two club aircraft are often available for instrument navigation practice at perpetually foggy Macau International Airport—which, in addition to having atrocious weather and no accessibility from Hong Kong by anything other than hydrofoil or aircraft, is increasingly hostile to general aviation because of increased commercial traffic. Only the club’s four helicopters, a restaurant, and the Aero Club Bar remain in operation at Kai Tak, and yet the slowly eroding former airport is the club’s best hope of continued operation.

Outside the Aero Club Bar, Hogan

*Hong Kong’s Kai Tak was one of the busiest jumbo jet hubs in the world.*

by Roger A. Mola

HENRY CHUNG



# Last Stand at Kai





# Tak

The Hong Kong Aviation Club clings to a corner of an abandoned airport.



Loh ties down a Robinson 44 helicopter. He squints up at the construction cranes and skeletons of the high rises being built across the airport's formerly flat expanse, then at the Kai Tak terminal. "There must be something on this airport worth preserving," he says. "We could make it a shrine to the old Kai Tak." Loh pauses to consider. "Well, why not... 'shrine'? That spirit is lacking in the second generation."

Loh is a past president of the aviation club, as well as the honorary secretary of the Hong Kong Air Cadet Corps, a civilian organization that is jointly sponsored by the government flying service, club members, and local universities and is headquartered on club property. A squadron of Loh's cadets can be found marching just outside the old terminal, following a peeling line on the ramp that once guided the nosewheels of Boeing 747s. Younger cadets take seats in an old departure lounge to hear an instructor lecture on lift and drag, his chalk squeaking on a blackboard.

Whenever a club aircraft can leave the ground, Loh asks the flier to offer a seat to a cadet. "We want the club to be Hong Kong's aviation development center," Loh says. "We plan to have a bachelor's degree program by 2005." Loh envisions 12-year-old cadets going on to earn an academic degree, get aviation career training, and then become dues-paying club members.

On this hazy Saturday, with a few hours' notice, the Army has again canceled all the club's flying slots at Shek Kong, grounding the cadets for another day. After he's done tying down the Robinson, Loh nods to the pilots playing cards on the wicker seats. " 'We persevere' is our motto," he says.

More disappointment lies ahead. The caretakers of the terminal will toss out the cadets by New Year's, along with the bowlers, car buyers, job seekers, shoppers, and squatters. The demand for living and business space in downtown Hong Kong is one of the reasons Kai Tak ceased operations. Overwhelming pressure to close the field had been applied years before the last airliner landed here, on July 5, 1998. On that flight—Dragonair no. KA841 from Chongqing, China—the pilot flew the approach over the steel skeletons

of new office towers, their construction halted at the maximum height allowable under the landing path. That night, a 24-hour construction effort began raising the towers to 20 stories, as if to add exclamation points to the permanence of Kai Tak's end. Now the terminal will be knocked down to yield even more land for development, the centerpiece of which is a 15-year Chinese government project to provide 260,000 housing units.

"Things disappear overnight in Hong Kong," says aviation facilities consultant and club member Cliff Dunnaway, who manages the Hong Kong Historical Aircraft Association's modest collection. Dunnaway designed a Kai Tak postage stamp issued the day the field closed, and would draft any future—and right now, unlikely—design for an expansion of the aviation club grounds. Dunnaway worries that the present grounds will be seized by the government as a work yard for construction of a rail station starting this year. "There's no push to preserve things," Dunnaway says. "The government tried to close the club by charging commercial rent of more than \$83,000, despite its heritage." Only because of an application to have the club's Nissen hut declared a historic landmark and the political connections of various members was the rent hike averted.

Dunnaway and Loh are charter members of the provisional aviation development council, a loosely knit group of club members and cadet officers trying to secure tax relief and development concessions—largely through behind-the-scenes political arm-twisting—aimed at preserving some of Hong Kong's 92 years of aviation history. "Our government can still bulldoze you down if they don't think you're important enough," Loh says.

The history Loh and Dunnaway wish to commemorate began in 1911, when aviator Charles Van den Born arrived from Belgium. He was bearing three crated Farman biplanes and hoped to fly from the only clear, flat patch available—a racetrack on Hong Kong island—but permission was denied. Instead, he dug in at Sha Tin, remote tidal flats nearby. On March 18, 1911, one of his Farmans—which he had dubbed *Wanda*—became the first aircraft to



*Kai Tak was best known among airline pilots for its apartment-skimming approach (top). Pilots would first sight the Checkerboard Rock (above) and turn their jumbo jets hard for the runway. An overshoot resulted in a splashdown in Kowloon Bay.*





HENRY CHUNG

crew called Myrtle. On Sunday morning, December 8, 1941—across the international dateline from Pearl Harbor—Myrtle was sunk at her moorings when 36 Japanese fighters smashed Kai Tak in a surprise attack. The airport's first two hard-surface runways—which were later abandoned—were constructed by prisoners of war under Japanese control.

Flying clubs of various stripes have been in place at Kai Tak since 1924, when two Chinese businessmen, Ho Kai and Au Tak, formed the Kai Tak Land Investment Company to drain the waters off Kowloon for housing. They raised the land but not enough cash. The fledgling Hong Kong Flying Club leased 60 acres of the new land and planted a grass field of 900 by 1,200 feet for a pilot school and a clubhouse. Nearby, the club set up moorings for flying boats.

The Far East Flying Training School, which had been operating before World War II, reopened after the British re-occupied Hong Kong, and the school expanded operations to 800 students and 50 instructors. In 1962, a typhoon—ironically named Wanda—decimated the school's hangars and wrecked its aircraft. The Aero Club of Hong Kong and the Hong Kong Flying Club—which combined in 1982 to form today's Hong Kong Aviation Club—took over pilot training, and by 1982 had graduated more than 6,000 students.

Last year, in an effort to expand business, the club opened its ground school to non-members. Within 48 hours, 29 students signed on. Because of daunting fuel and insurance costs, introductory flights run \$345 per hour. With the help of the Government Flying Service—the descendant of the Royal Hong Kong Auxiliary Air Force, which provides search and rescue, firefighting, and patrol—the Corps has mushroomed to 2,200 cadets between the ages of 12 and 18, plus 400 adult officer cadets, all of whom will soon be able to gain rotary-wing training in the club's Robinson helicopters.

If Loh's vision is realized, the club will continue its tradition of helping new pilots into the sky. "When I was very young, my uncle used to bring me to Kai Tak every single weekend," says 18-year-old cadet Jimmy C.M. Leung.



HENRY CHUNG

fly in Hong Kong.

The first commercial landplane flew from Kai Tak in 1936, and later that year, 4,000 spectators watched Juan Trippe of Pan American Airways splash down off Kai Tak in a Martin M-130 flying boat as he

*Hogan Loh (right) hopes training Hong Kong Air Cadets like John Lam and Mei Wong will help keep Kai Tak's rich aviation heritage—and the club itself—alive.*

mapped out Far Eastern routes for his expanding airline. The next year Trippe instituted weekly service to Manila, with connections to San Francisco, in a Sikorsky S-42B flying boat that her



"At that time I imagined how exciting it would be to pilot the aircraft by myself—and the time soon comes!"

Leung won a scholarship to Australian Aviation College in Adelaide through a program jointly sponsored by Cathay Pacific Airways, Swinburne University of Technology, and the Government Flying Service. But despite growing its cadet rolls, the club has lost 30 percent of the members it had before the airport closed—many of them British subjects who returned home after mainland China took over Hong Kong in 1997, as well as the pilots and aviation workers who no longer stop by for a drink after landing a jumbo or leaving their office. "About 25 percent of the social members are out, and many of the expatriates are gone," says club manager Chris Lau. "All of the former airport workers are gone."

The club counts 500 full members who each pay an entrance fee of \$4,166. Some members resist the changes—the push to expand services to non-members—and nothing can really replace the loss of a vital, exciting airport that once surrounded the club. Some of the remaining members would rather drink to the memories of the past. "There is a faction that wants [the club] bulldozed rather than opened to the public," says Dunnaway.

"A lot of the [airline] pilots used to radio that they would walk around to meet us at the aviation club bar," says former Kai Tak air traffic controller John L. Wagstaff, who transferred to the new airport. "The inner circle in the old tower was a more homey feel. It's not the same at Chek Lap Kok, because of the sheer size and the long commute home." Wagstaff worries that general aviation cannot survive the development: "Only money speaks, and in Hong Kong land is money."

To help recapture a small part of the magic, the club's long-term plans include an aviation-themed complex designed by Dunnaway that would be combined with the aircraft tie-down area. A Cathay Pacific DC-3, which now hangs in the Hong Kong Science Museum, would be one of the attractions. The restaurant, the 13/31 Lounge, would memorialize Kai Tak's infamous runway, which treated jumbo jet pilots and passengers to a hair-raising ap-

proach that scarcely skirted the tops of surrounding apartment buildings.

On the descent to Runway 13 was a visual navigation aid above the airport known simply as the checkerboard, an orange and white pattern that was painted on a concrete-faced slope in 1973. It loomed large in the windscreens of jumbo jets that once flew at its sheer rock face at nearly 200 mph and 675 feet above Kowloon City, often while being buffeted by Hong Kong's subtropical air masses. There was no time to glance at instruments; just before the checkerboard, pilots sighted Runway 13 out their right windows and turned their Concorde, Boeing 747s, or Airbus 300s 47 degrees hard right.

Other airports have final approaches that can be visually flown, says Cathay Pacific Airways general flying manager Andrew Maddox, who flew Boeing 747s from Kai Tak. "But I am not aware of any other that had the combination of factors resulting in the degree of difficulty associated with [Runway] 13." Once they were over the runway and abeam of the aviation club, airline captains flared their jets, then stood on the brakes to avoid coming to rest in Kowloon Bay—a fate that, on average, befell at least one airliner a decade.

Flying out of Kai Tak was no less challenging and depended on tower controllers forcing airliners to remain at their gates until adequate taxi space cleared. With departure and approach corridors limited by the mountainous terrain, precise timing was the key.

"We had two 90-degree turns between the holding point and the runway threshold," says Phil Parker, who spent 12 years working in Kai Tak's control tower. "It takes up to one minute for a loaded 747 to line up, then one minute to get airborne. Meanwhile an aircraft flying 180 knots on final has gone six nautical miles. If a landing jumbo missed the approach just as another departed, the two flew in trail between mountains for six miles dead ahead through the Lei Yue Mun Gap. All we needed was one runway length between the departure and the landing to be legal."

Indeed, all of crowded Hong Kong seemed to have some relationship to the airport. Beneath the checkerboard

a miniature golf course once taunted putters with a foot-high Great Wall of China. In the midst was a navigational localizer, while nearby, elderly people participated in a morning tai chi class. The landing aids and mini-golf are gone, but the checkerboard remains a potent symbol to planespotters like Parker, who often mixed business with pleasure. "I'd clear them to land, then pick up my camera," he grins.

Loh also laments losing the drama

*Air Cadets march smartly across a taxi line that guided 747s. Many win state-sponsored scholarships that pay for the aviation club's flight orientation and training—but if developers prevail, the cadets' dreams of a cockpit seat in an airliner like the Cathay Pacific Boeing 777 (below) may be bulldozed with the club's grounds.*







ROGER MOLA



LAWRENCE CHIU

of Kai Tak's legendary approach. He points out the weeds sprouting from the checkerboard, which is today crumbling under the constant movement of the hillsides. "There's no purpose for it now," he says.

Luckily for the club, most of the heavy development plans for the airport are focused on Kai Tak Point, which is at the opposite end of the runway from the club. Among the potential additions are an IMAX theater, 50,000-seat stadium, two hotels, a hospital, 28 schools, and a cruiseship terminal with helipad. One group of astronomy enthusiasts wants a 100-story observatory, and the Hong Kong tourism board may build replicas of Chinese junks to sail by the former runway.

Every new deal or development plan seems in some way to threaten the club's future. In January, Disney's Michael Eisner, martial arts actor Jackie Chan, and Hong Kong chief executive Tung Chee-hwa broke ground for a new Disneyland on Lantau Island, where Chek Lap Kok International is located. Both Loh and controller Phil Parker predict that Disney fireworks—which would be directed over water and into one of general aviation's only areas open for unrestricted visual flight rules—will necessitate new limits for club fliers and cadets.

In addition to the hoped-for aviation playground, there is hope for a proposed aviation museum where Oriental Golf City has taken root on the runway. Loh and Dunnaway's efforts are aimed at helping the museum become a reality; doing so bolsters their chances of keeping the club's buildings standing. But Loh scoffs at the museum's chances: "That's many, many years down the road if at all," he says.

Months before Chek Lap Kok opened, the Hong Kong Historical Aircraft Association built a replica of Charles Van den Born's *Wanda* and flew it from the new airport's vast runways. The aircraft was then hung from the ceiling in the new terminal, a placement that Cliff Dunnaway thought was permanent. "Last year the airport marketing staff told me an airplane didn't fit their vision for a retail experience, and wanted it out," he says.

Like the heritage it represents, *Wanda* has been left hanging. ✈



# The Rest of the Rocket



*Helmut  
Gröttrup  
(right,  
crossing Lake  
Seliger)  
chose to  
work for  
the Soviet  
Union,  
but not  
to live  
there.*



In the closing weeks of World War II, as Allied troops rumbled into German towns and the victors jockeyed to divide the spoils, one prize stood out: the people and machinery that had produced the V-2 rocket, one of the

man to the moon. In the mid-1990s he wrote *Rakety i Lyudi (Rockets and People)*, a monumental four-volume memoir that became a bible for space historians around the world.

When I met Chertok in Moscow last

come a bit player on von Braun's team. Chertok thinks the primary reason was Gröttrup's wish—and the even stronger desire of his wife Irmgard—to stay in Germany. He doesn't discount, however, the scientist's left-wing politics. "He was what we would call a social democrat—definitely anti-fascist," Chertok recalls.

For whatever combination of reasons, Gröttrup signed up with the Soviets, who established a rocket research institute in the town of Bleicherode, not far from the Mittelwerk plant, and set him up with a \$1,250 per month salary and a spacious house (the own-

# Scientists

war's most exotic weapons. To the delight of U.S. intelligence, Wernher von Braun and most of his top associates on the V-2 development team chose to surrender to the Americans, shrewdly calculating where they might be allowed to continue their pioneering research after the war. One German rocket engineer, quoted by historians Frederick Ordway and Mitchell R. Sharpe in their book *The Rocket Team*, sized up his options in April 1945: "We despise the French, we are mortally afraid of the Soviets, we do not believe the British can afford us. So that leaves the Americans."

On June 20, 1945, von Braun and about 1,000 other German engineers and family members made the exodus from east Germany into the U.S.-held western zone, just ahead of the advancing Red Army. When the Soviets arrived, they found the V-2 underground production center at Mittelwerk mostly abandoned, its top personnel gone and key documents missing.

Among the disappointed Russians was 33-year-old Boris Chertok, an aerospace engineer who had arrived in Germany two months earlier with a broad assignment to search for and evaluate Nazi technology, particularly the V-2. Today a consultant at RKK Energia, the company that built the Mir station and other Russian spacecraft, Chertok's career in the space industry goes back 65 years, including work on the Soviet attempt to send a

After the war, the United States got Wernher von Braun and the A team. The Russians got the other guys.

year, his health was declining, which slowed his movements and forced him to talk loudly to overcome deteriorating hearing. Yet his memory of events that took place half a century earlier was still vivid. He recalled the scramble in 1945 as he and his colleagues tried, with little success, to lure top German talent to the Soviet side. His emissaries made risky dashes into the American zone, approaching the rocket specialists with offers of hefty salaries, food rations, and—most importantly—the opportunity to stay in Germany. That was one of the few battles von Braun and his colleagues had lost in negotiating with the Americans, and the Soviet recruiting campaign appealed to the Germans' longing to remain in their homeland.

Few took the bait. One who did was Helmut Gröttrup, a physicist by training and a top expert on the V-2's flight control system. Historians have debated why Gröttrup turned down the offer to work in the United States, suggesting that it was a combination of his leftist views and his refusal to be-

er, an affluent merchant, was rudely turned out, according to Ordway and Sharpe). Gröttrup's first task was to compile a detailed report about the rocket research he and his colleagues had been engaged in at the Peenemünde center on the Baltic coast. He also was placed in charge of hundreds of Germans, whose main job was to produce a full set of drawings for the V-2 and re-start production. Irmgard volunteered to search for food and other provisions for institute personnel in the midst of devastated Germany.

It wasn't long before the other shoe dropped, however. As flightworthy V-2 missiles started rolling off the restored production line in 1946, the Soviet government made a secret decision, signed by Josef Stalin on May 13, to transfer all ballistic missile work, along with the German rocket experts, to Russia by year's end. Ivan Serov, the head of the Soviet secret police in Germany, devised a plan, code-named "Osoaviakhim" after a Soviet aeronautical organization, to accomplish the deportation in just five days, with no advance notice. As Serov bluntly put it, moving quickly and relying on the element of surprise would "prevent Germans from running away when they learn that So-

by Anatoly Zak



viet organizations deport their German employees." Some 2,500 security officers were assigned to the operation, along with regular army units.

Chertok, who had tried hard to build good relations with his new recruits, favored the decision. "I believed it was a useful step," he says. "We worked with Germans almost a year and a half, achieved a lot, and I considered it necessary to continue in Russia for some period of time."

Not everyone agreed. Chertok's friend and colleague, Sergei Korolev, who would go on to lead the stunning Soviet space achievements of the 1950s and 1960s, despised the move. In 1946, the man who would later become the Soviets' chief designer for space nurtured ambitions of building his own rocket team. "Korolev had a negative attitude toward German participation in our work from the very beginning," says Chertok, "and he did see them as potential competitors."

The German engineers had little warning of what was coming. Early in the morning of October 22, 1946, Soviet soldiers showed up at the homes of top technical workers and informed them that they would be deported to work at various Soviet industrial ministries. It was the same story at each house: A Soviet security officer, accompanied by an interpreter, shocked half-asleep families by ordering them to pack up personal belongings and prepare to board trains for Russia. A promise of a five-year contract in the Soviet Union and an offer of assistance with packing and moving were little consolation. According to recently published Soviet accounts, as many as 7,000 workers and family members were rounded up. Only 500 or so were rocket engineers and their families—the rest worked primarily for the aircraft and nuclear industries.

When an angry Helmut Gröttrup asked when he and his colleagues might return to Germany, Dmitry Ustinov, the head of the ministry responsible for missile development, joked, "As soon as you can fly around the world in a rocket!" Gröttrup boarded one of the 92 trains transporting the deportees and immediately dictated a letter of protest to his secretary, but it was to no avail. He arrived in Russia a few days later.



*Once a Soviet rocket research center, Gorodomlya Island now has regular ferry service for tourists. Many are unaware of the island's secret past.*

and birch trees, gravel roads, and unpaved trails, twisting between ageless wooden cottages with brick chimneys and glass-covered porches. Back then, the hemorrhaging Soviet economy left local food stores largely empty, prompting my mother, in her never-ending quest for groceries, to make frequent trips to nearby Podlipki, where the shelves always seemed well stocked.

Official Soviet encyclopedias listed timber production as Podlipki's main industry, but even then we knew it was home to the rocket industry, whose privileged workers could find cheese and milk even during the worst shortages. It wasn't until the 1990s that the town's true mission was made public, and it was renamed Korolev to honor the luminary of the Soviet space program, who spent the most productive years of his life there. It was here that Helmut Gröttrup was sent, to work at the newly established NII-88 scientific research institute, the first Soviet industrial facility dedicated to rocket development.

Boris Yezhov, a Korolev town historian, says that about half the Ger-

Growing up in Moscow in the 1970s, I spent my summer vacations at a dacha in Valentinovka, in the city's northeastern suburbs. It was a place of magnificent pine

mans were accommodated in vacation houses in the northeastern suburbs. Most of the residences no longer exist, but at least one, in Bolshevo, is still standing. On the way to see it, Yezhov showed me an old black-and-white photo of a majestic stone mansion, sitting oddly in the middle of a forest. Today it's a vacation house for Russian movie executives. But when Germans lived there it was nicknamed the "Fascist Palace," and it housed "I don't know how many tenants," according to Irmgard Gröttrup. She and Helmut moved into a six-room villa more befitting his status, and were given a chauffeur-driven BMW. Later, though, when Helmut was transferred out of Moscow, Irmgard would spend a few months in the Fascist Palace. During her first night in the crowded building, her Russian hosts asked when she and her fellow Germans were going to bed. She recalled, "We looked at the 10 bottles of vodka on the table and laughed out loud: We hadn't the slightest intention of going to sleep."

Other Germans were housed according to their jobs. Specialists in guidance and radio systems, perhaps the most challenging task in the Soviet missile development program, settled in the town of Monino, farther east on the Yaroslavskaya Railroad. Another group, led by V-2 propulsion specialist Erich Putze, was attached to the collective of Valentin Glushko, the other principal figure in Russian rocketry at that time. Glushko worked on rocket propulsion systems at the OKB-456 design bureau, now known as NPO En-



ergomash, the company that builds engines for almost every Russian rocket as well as the U.S. Atlas booster. Like Korolev, Glushko was not enthusiastic about German participation in his work. “He distanced himself from the Germans,” says Vladimir Sudakov, a historian at NPO Energomash.

Without support from above, Gröttrup struggled with badly equipped laboratories and a lack of tools. The Germans working for Glushko were taken off work on a more advanced engine for the V-2, designated RD-102, and given secondary and often humiliating jobs, such as designing the foundation for industrial buildings.

For the Russian rocket pioneers, it was partly a matter of pride. Korolev and Glushko had been at this business for years, and believed they could improve on the already outdated V-2 with no outside help. But Stalin himself was keen to have his scientists launch German missiles before moving on to their own. He believed that by copying Western designs, like that of the American B-29 bomber (see “Made in the USSR,”

Feb./Mar. 2001), Soviet engineers could quickly absorb foreign innovations. Decades later, veterans of the Soviet aerospace industry publicly admitted they had done just that.

So in August 1947, Gröttrup and several other Germans boarded a train to a new launch range at Kapustin Yar, near the border with Kazakhstan, to assist with the first launches of V-2s. Out here, Irmgard wrote in her diary, the camels outnumbered the cars. Still, the engineers were excited to be launching rockets again. The atmosphere, she noted, was “just like Peenemünde when we made our first experiments.”

Upon returning to Moscow in December, the Germans continued to be shut out of important work. Gröttrup and his associates presented to their Russian hosts a concept for a new guided missile, the G-1, partially based on work done in Germany during the war. Also designated the R-10, it featured a number of improvements over the V-2, including a longer range. But despite positive Russian reviews of the concept, it went nowhere. Soon German

engineers began losing their positions at NII-88 and were reassigned to a research facility on Gorodomlya Island, 200 miles northwest of Moscow, where half their fellow Germans had already been living since arriving in Russia.

Helmut Gröttrup had few regrets about leaving the frustration of NII-88, but his wife felt a pang of nostalgia: “Farewell Moscow!” she wrote. “In spite of everything, you meant a great deal to me—a host of good friends—a city, in which I quarreled, laughed, wept, and pondered much.”

In the Upper Volga region of Russia, surrounded by swamps and evergreen forest, lies magnificent Lake Seliger, and at its center, Gorodomlya Island. In 1629 a rich landowner donated the island to a Russian Orthodox monastery, and for most of the three centuries that followed, Gorodomlya remained virtually uninhabited. Mid-19th-century maps of the island show the lone house of a forester. In 1928 the Soviet government evicted the monks and established a biological research laboratory. According to local legend, one of the defiant monks drowned himself in the lake, and his ghost has wandered the island ever since.

The region around Lake Seliger saw heavy fighting during World War II, and the laboratory was evacuated in the face of the German advance. By



*After their arrival in Moscow in 1946, German rocket experts were housed in this mansion in the northern suburb of Bolshevo—prompting locals to nickname it the Fascist Palace. Today (right) it's a vacation home for Russian film executives.*



**When an angry Helmut Gröttrup asked when he and his colleagues might return to Germany, Dmitry Ustinov, the head of the ministry missile development, joked. “As soon as you can fly around the world in a rocket!”**





*On Gorodomlya, the Germans faced spartan conditions but did their best to improve their new homes. Above: Helmut Gröttrup chops firewood; right, wife Irmgard plays tennis on a court built by Germans.*

the war's end, Gorodomlya had become home to numerous Soviet military hospitals, and was connected with the outside world by an underwater telephone cable. But its real claim to fame was the rocket

research conducted there in the years immediately following the war.

It took Gröttrup and his fellow Germans days to reach the island from Moscow, but I made the trip in five hours by car. From the shores of Lake Seliger, I boarded a ferry that takes a half-hour to reach Gorodomlya. Not far from the pier is a gated entrance and a guardhouse. By the time I reached the gate, it was already under siege by a group of teens from our ferry, who were quarreling loudly with a female guard. Apparently they were here for a dance party at a nearby club, and some of them did not have permits to be on the restricted island.

As I climbed the road past the security fence, I could appreciate Irmgard Gröttrup's feelings when she arrived here a half-century earlier: "So great was our curiosity about the island that we hardly noticed the dreaded barbed wire once we had landed. I think we were all too anxious to know what went on behind it." At the top of the hill, the asphalt road took me around a white stone building marked "LIBRARY." It used to be a café, which



doubled as a social club for the Germans. The newcomers, it seems, tried to make it feel like home.

"The camp looks like an outsize toy village transplanted from Germany," Irmgard wrote. "There are flowers in the touchingly well-tended gardens, and on the balconies, the windows are curtained and the washing on the lines is spotless." More than 50 years later, a visitor can still find many houses at Gorodomlya surrounded by rose bushes, their bright flowers striking a dissonant note in that harsh landscape.

The German engineers and their family members could obtain permits to leave the island, but only for limited periods, and only with a Soviet escort. According to Valery Bukreev, a Russian engineer who has lived on Gorodomlya since the 1960s, the week-

**"So great was our curiosity about the island that we hardly noticed the dreaded barbed wire once we had landed," wrote Irmgard Gröttrup in her diary. "I think we were all too anxious to know what went on behind it."**

ly trips German housewives made across the lake drove up prices at the local produce market. During winter the lake iced over, and the wives pulled sleds loaded with provisions. During spring thaws the trip became more dangerous, and Irmgard Gröttrup remembered watching Russians hop from one piece

of floating ice to another.

Compared to Moscow, life on the island was primitive. The first German families to arrive had been given apartments with no bathtubs but plenty of bugs. (I learned on my first morning there that the descendants of these bloodsucking insects remain.) Eventually, after much bickering with the Soviet authorities and their own efforts on the weekends, things improved. In the summer of 1948, the Germans built a tennis court. "Even today," Bukreev says, "the surface of this court gets dry in minutes after the rain, so well was it laid out." The Soviets provided schools, which had 150 German students at one point, some of whom went on to college in St. Petersburg.

The real problem, though, was not the living conditions or even the lack of freedom, but disillusionment with the work. Gröttrup was pleased with the caliber of his German colleagues, who were well equipped and had more cohesiveness as a unit than he had seen back in Moscow. Although only a few had worked at Peenemünde, he quickly discovered a number of brilliant specialists on his new team: Joachim Umpfenbach, responsible for propulsion systems; Waldemar Wollf, a ballistics expert; aerodynamicist Werner Albring; Johannes Hoch, who led the team developing flight control systems; Alois Yasper, in charge of production; and Heinz Jaffke, who headed construction of launch facilities.

But politics worked against them. "There was a suspicion toward any foreigner in the U.S.S.R.," says Alexander



Eremenko, a historian of NII-88, and the Germans at Gorodomlya were physically and intellectually isolated. Back in Moscow, Korolev was building a vast industrial network for rocket development, but the Germans were unable to test their concepts or even collab-

ther discussion of building the G-1 rocket. Soviet officials continued visiting the island over the following year, seeking proposals for various rocket concepts, but nothing came of any of them.

By the end of 1950, with no prospect of returning home and no hope of creative engineering work, Gröttrup asked visiting Soviet officials to relieve him of his duties as head of the German collective. He hoped that as a show of solidarity, none of his German colleagues would agree to fill his position. He was wrong. Johannes Hoch, the flight control system expert,

death could have been one of our chief designers.”

By the time Helmut Gröttrup walked away from his job, the Soviets had gotten about all they wanted from their foreign experts. As more newly trained Russian engineers took over key jobs on the island, the Ministry of Armaments decided to discontinue the German collective’s missile development project, and the secret work at Gorodomlya ceased. Around the same time, back at the OKB-456 design bureau, Glushko authored a document essentially asking the government to send the Germans back home. Meanwhile, the German scientists were assigned such tasks as designing aerodynamic weighting mechanisms or boat engines. Depression, heavy drinking,

and even suicide attempts plagued the team and their families.

In 1951, the first group of Germans was allowed to re-

**When the Soviets launched Sputnik 1, one high-ranking official at NATO’s European headquarters reportedly exclaimed, “We captured the wrong Germans.”**

*Stalin had his rocket engineers launch V-2s before moving on to their own R-1 (left). The Soviet RD-100 (right) copied the V-2’s engine.*



ENERGIA

orate with anyone off the island.

Korolev was trying to push his own rocket design through the bureaucracy at NII-88. In many ways his R-2 paralleled the Germans’ G-1 concept. Both rockets minimized weight and added range. And both featured a separable warhead, so the rest of the missile wouldn’t have to survive the scorching heat of atmospheric reentry.

Three days after Christmas 1948, a delegation from NII-88 arrived at Gorodomlya to review progress on the G-1 project. Gröttrup bluntly told his bosses that further development of the rocket made no sense unless he and his co-workers were allowed to do experimental work. The review ended on a positive note, but there was no fur-

was appointed to take his place. But only four days later, possibly due to negative reactions from other members of the team, Hoch and five of his supporters were transferred to Moscow to join a team developing anti-aircraft missiles; it was led by Sergei Beriia, the son of Lavrenty Beriia, Stalin’s infamous secret police chief. Boris Chertok agrees with Irmgard Gröttrup’s perhaps biased characterization of Hoch as a “crypto-Communist.” According to Chertok, Hoch applied for Soviet citizenship and even tried to join the Communist party. “He also was an extraordinary talented engineer,” says Chertok, “and if not for his premature





turn to East Germany. The Gröttrups remained until November 1953, when all but a few of the remaining Germans were sent home. The rest, mostly guidance experts, eventually were transferred to Moscow. Helmut and Irmgard returned to Germany and even succeeded in moving back to the western sector. Again Helmut was offered a job in the United States, and again he opted to stay in his home country. He went on to a successful career in the electronics industry, and turned his back on the past.

On August 21, 1957, the Soviet news-

**There was a suspicion of any foreigner in the U.S.S.R., historians note, and the Germans at Gorodomlya were physically and intellectually isolated.**

paper *Pravda* boasted that the U.S.S.R. was in possession of intercontinental ballistic missiles. As Western intelligence confirmed the Soviet claim, one high-ranking official at NATO's European headquarters reportedly exclaimed, "We captured the wrong Germans."

His comment was based on a rather common belief in the West: that Soviet breakthroughs in rocketry, including the triumphant launch of Sputnik 1 a few weeks later, were due to the contributions of German rocket scientists. When Wernher von Braun and his team answered Sputnik the next winter with the first U.S. satellite, Explorer 1, a popular joke was that the two orbiters exchanged greetings in their common language—German.

Historians, however, disagree about the impact of German rocket scientists on the Soviet program. "In reality, the Germans did not build anything for the Russians, did not 'supervise' the firings, and did not introduce innovations," wrote German-born rocket historian (and von Braun colleague) Willy Ley in 1968. Nearly three decades later, Boris Chertok echoed the opinion in his memoirs. The R-7, the Soviets'

first ICBM and the vehicle that launched Sputnik, bore no German "birth marks," he wrote.

However, Olaf Przybilski, an historian at the Technical University of Dresden, disagrees. His analysis, published in Germany in 1997, points out a striking resemblance between a cone-like aerodynamic shape the Gröttrup team had proposed for several rockets and

V moon rocket, rise to the top levels of agency management, and win the National Medal of Science. Kurt Debus, another Peenemünde alumnus, headed launch operations at Cape Canaveral during the Apollo program. Helmut Gröttrup was happy just to make it back home to Germany.

After the 1991 collapse of the Soviet Union, some of the surviving "Rus-



the conical shape of Korolev's largest designs—the R-7 and the ill-fated N1 moon rocket.

The truth lies somewhere in between. Germans did not design the Sputnik or its rocket, but the ideas developed by Gröttrup's team on Gorodomlya did influence Soviet designers and accelerate their efforts. On her last day on Gorodomlya Island, Irmgard Gröttrup wrote in her diary: "Once more we had a meal with our friends, draining glass after glass and taking stock of the past years. We came to the conclusion that they had not been wasted, as we had so often believed. The men agreed that...the long-range rocket has made the conquest of space a definite possibility in the foreseeable future."

Whether or not their work ultimately mattered, there is no question that the Germans who went east after the war had a markedly different experience from those who headed west. Wernher von Braun would eventually supervise construction of NASA's Saturn

sian Germans," as the rocket scientists had come to be known in their homeland, returned to Russia for a reunion with former friends and colleagues. Among them was Ursula

Gröttrup, the daughter of Helmut and Irmgard and now a woman in her late 50s living in Hamburg. Back on the island, she found her childhood home still standing, and learned that shortly after her family left, a new organization began producing gyroscope technology for Soviet rockets and spacecraft. Some of that hardware eventually flew on the Buran space shuttle and the Mir space station in the 1980s. Finally, something made on Gorodomlya made it to the launch pad. ➔

*Apartments that housed German engineers in the 1940s still stand today on Gorodomlya. By the time the Soviets launched Sputnik, the Germans had all gone home.*



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## SIGHTINGS

**L**ike most visitors to Key West and the Great Barrier Reef, underwater photographer David Doubilet was enchanted by the shifting seascapes and colorful marine life. But his fascination with aircraft recently led him to photograph the sea in a different way, using vintage aircraft to offset nature's beauty. "I love to get above the sea to better understand its complex architecture or explore its dark brooding nature from another perspective," he says. "An old aircraft gives the picture a touch of drama and even a bit of romance."

Right: Once Doubilet saw Key West from a 1940 Waco UPF-7, he knew the shot he wanted: "We set down, and an hour later I was in a Cessna photographing the orange-red biplane as it slowly made progress between blue sea and sky." Fred Cabanas, Doubilet's pilot and the owner of Island Aeroplane Tours, flies over the Florida coast daily, towing banners and giving tourists a bird's-eye view. Yet he still finds the beauty below hypnotic. "Never get tired of it," he says. "Ninety percent of the time I am over the water I see turtles, dolphins, and even the occasional ocean sunfish."

Above: Viewed from the sky, Australia's Hook and Hardy Reefs (parts of the Great Barrier Reef) bloom like orchids from a dark blue ocean. Diving with friends, Doubilet reached the reefs via one of Air Whitsunday's de Havilland Beavers. "We surfaced to see another Beaver taking off in the distance. There was a photographic moment when I was granted the rare view of corals, brightly colored fish, the silver surface of the sea, and a white plane dripping seawater clawing into the sky—all in one frame." Done for the day, Doubilet's airplane caught up with the other Beaver, enabling him to take this photograph when "plane and reef materialized out of the sea haze."









# Wings of Madness:

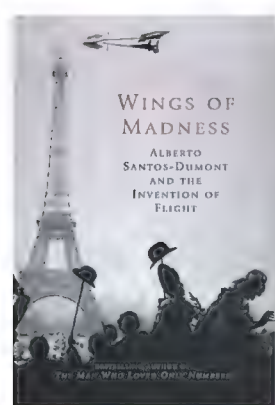
Alberto Santos-Dumont and the Invention of Flight

by Paul Hoffman. *Theia*, 2003. 347 pp., \$24.95.

In 1901, Alberto Santos-Dumont, a Brazilian who had emigrated to France, electrified Paris by appearing in its skies at the control of a powered balloon. The diminutive, dandified Santos-Dumont went on to become an international celebrity, but he did not invent flight, as *Wings of Madness*' subtitle implies. That honor is accorded to the Montgolfier brothers, who rose to the occasion in a hot-air balloon in 1783.

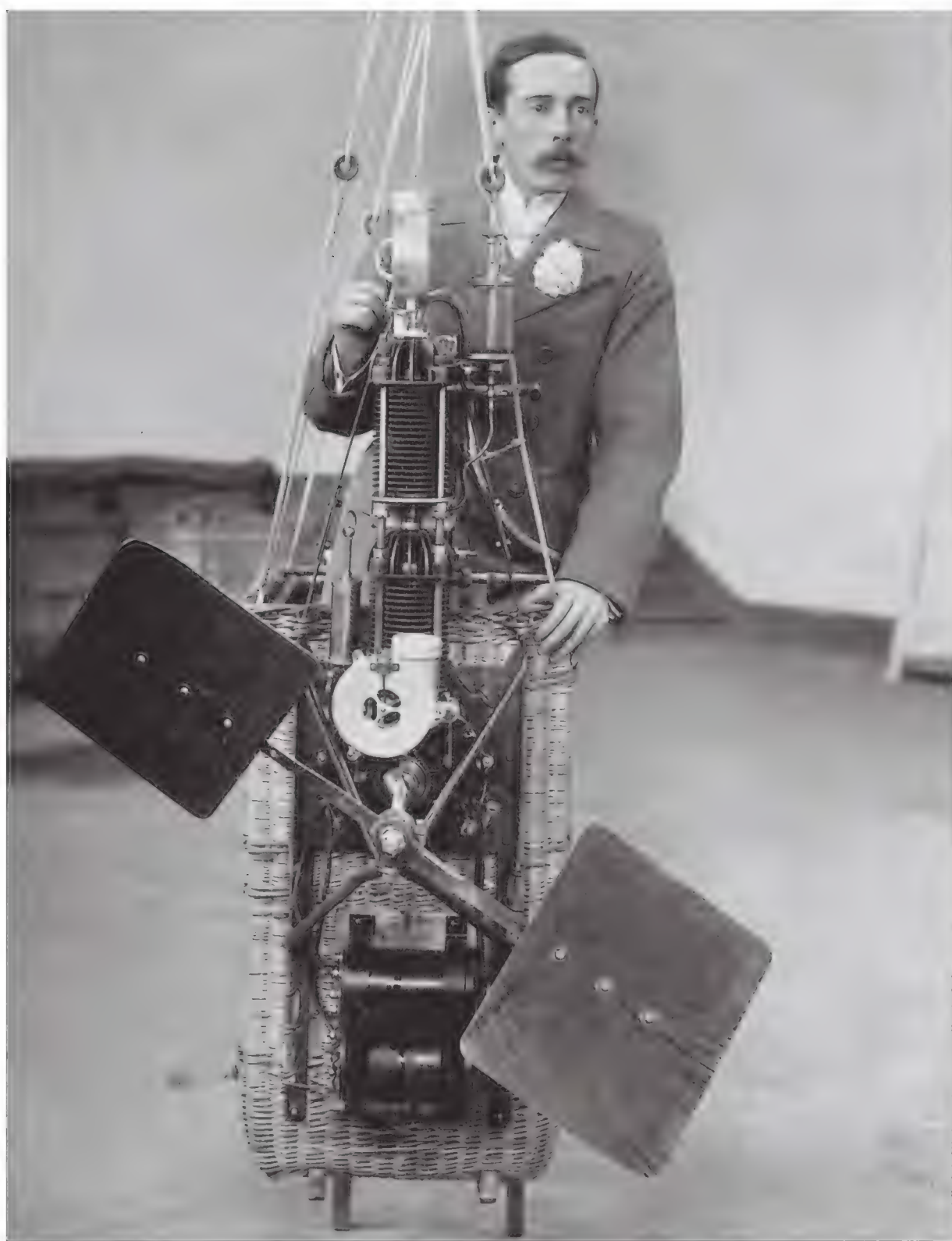
Santos-Dumont's accomplishments can be summed up thus: He devised a way to power and control balloons, using

lightweight internal combustion engines, and he made some progress in heavier-than-air flight. Through it all, he functioned as his own test pilot. In 1903, he built a small



powered balloon christened the *Baladeuse* and used it to visit friends and restaurants. Hoffman creates an irresistible picture of Santos-Dumont handing the *Baladeuse*'s mooring line to the doorman at Maxim's.

Beginning on page one, Hoffman drops broad hints about Santos-Dumont's sexuality. This could have been covered in one paragraph, but



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Alberto Santos-Dumont in the basket of his No. 1 airship, a one-person, pusher-prop dirigible that crashed and deflated on successive flights in September 1898.

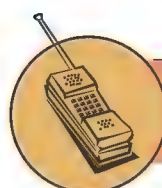
Hoffman revisits the topic throughout the book: For example, with apparent relish, he reprints an overlong newspaper article that notes that Santos-Dumont knits, has a vanity table in his bedroom, wears jewelry most often associated with women, and—heavens to Betsy—has never married.

This speculation is a distraction, since Hoffman never shows how Santos-Dumont's sexual orientation could have affected his aeronautical activities.

When *Wings of Madness* addresses

aviation, it holds the reader in thrall. But when the author strays, even the most dedicated reader can be driven from the page. An account of Santos-Dumont meeting Thomas Edison, for example, becomes a biography of the Wizard of Menlo Park. Author Marcel Proust surfaces, and we are treated to a discussion of *his* love life. A mini-history of World War I appears, and a discussion of Henry Ford's aviation activity puts Ford out of the plane-building business years before the exit actually occurred.

Still, we learn much about the tiny Brazilian. Accompanied by generous illustrations, Hoffman's text introduces a



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shy, sometimes reclusive genius who moved easily among royalty, the rich, and an adoring public. We learn also of the man's emotional problems, including a penchant for fact-bending, and hear of his repeated stays in a sanitarium.

Hoffman's most valuable contribution is to place Santos-Dumont in the context of his time. Without even third-hand help from the secretive Wright brothers, but with limited consultation with French aviation pioneers Louis Blériot and Henri Farman, Santos-Dumont became the first man to fly an airplane—one that he built—on the continent of Europe.

—William Jeanes lives in Pass Christian, Mississippi, and is a former editor-in-chief of Car and Driver.

## In the Company of Heroes

by Michael Durant. G.P. Putnam's Sons, 2003. 363 pp., \$24.95.

During the first week of October 1993, Michael Durant's bloody, battered face appeared on the cover of *Newsweek*, *Time*, and *U.S. News and World Report*. Unprecedented in news publishing, the concurrence showed how focused the nation was on the sole prisoner of a disastrous military operation in Somalia. Code named "Task Force Ranger," an elite mixed force was assigned to carry out a series of "snatch and grab" operations to capture Somalia's controlling warlord, Mohamed Aidid, and his henchmen, in an effort to bring peace and stability to the nation.

Mark Bowden's excellent book, made into the gripping movie *Black Hawk Down*, presents the big picture of the action, which lasted about 17 hours. Durant, the pilot of one of the two Black Hawk helicopters shot down early in the operation, writes about what he saw of the action. Badly injured and the sole survivor of his craft's crash, he is defended by two brave Delta operatives,

then taken prisoner by a mob of enraged Somalis.

Durant was given a bible by a Red Cross worker, and used it to record in code his daily activities, an accounting that would serve to

document his captivity if he disappeared. In this case, it was a great help in recalling the specifics of his ordeal. Between the chapters dealing with his captivity, Durant fills us in on his career leading up to the action in Mogadishu. As

a pilot for an elite "Night Stalker" special operations unit, he was no stranger to combat or tough situations; a seasoned and experienced pilot, he had proven himself in the Gulf, in Panama, and in Desert Storm, but it was as a prisoner that he faced his greatest challenge.

His treatment varied from confinement in empty darkened rooms, where he feared for his life, to having a bed, radio, and other small amenities, such as a toothbrush. He tuned the radio to the U.S. Armed Forces radio frequency and listened to news of efforts to free him, music dedicated to him by his friends, and even a taped message from his wife. Durant's captivity lasted 11 turbulent and painful days, but recovery from a broken back, a broken leg, and facial injuries took far longer. His courage, determination, and the support of his unit and his friends served as inspiration on his road to recovery. *In the Company of Heroes* is an intense, must-read book, one of the most powerful chronicles of bravery I have read in a very long time.

—U.S. Air Force Lieutenant Colonel Bob Hanson (ret.) saw action as a fighter pilot in Vietnam.

## No Visible Horizon

by Joshua Cooper Ramo. Simon & Schuster, 2003. 288 pp., \$24.

Aviation consists of many groups of pilots convinced that their specialties puts them among "the best." Some land jets at night on carriers. Others shepherd 400-ton wide-bodies to fuel-critical landings at IFR minimums. Yet others fly the Arctic bush with minimal equipment, improvising every moment. There are crop-dusters, helo medevac pilots, Society of Experimental Test Pilot members, air racers...

The very first sentence of this often-silly book—absent an incomprehensible prelude about 15th century haiku and the author heedlessly doing aerobatics amid clouds—reads "The best pilots in the world, perhaps 60 men and a dozen women, compete in Unlimited Aerobatics." One needn't read much further to understand that author Joshua Cooper Ramo says this because he feels that he, a sportsman-class national aerobatic contender, deserves something approaching that rank.

As a writer, Ramo hyperventilates so badly he needs to put his head between his knees. Firing off more four-letter words than a season's worth of

## FOR THE KIDS

### Space Dogs: Pioneers of Space Travel

by Chris Dubbs. Writer's Showcase, 2003. 90 pp., \$11.95.

Elementary schoolers will lap up Dubbs' tales of Laika and other canine trailblazers. Follow along with the "man with the thick glasses" as he trains strays for rocket flights and orbital missions in this charming yet frank dramatized account of the secret Soviet space dog program of the 1950s and 1960s.



"Sopranos" episodes, Ramo can turn even the description of a relatively routine cross-country flight into a dance with fiery death. What he does in his descriptions of world-class aerobats and serious aerobatics beggars belief. The book is filled with errors and thrice-told tales that have become pure fable.

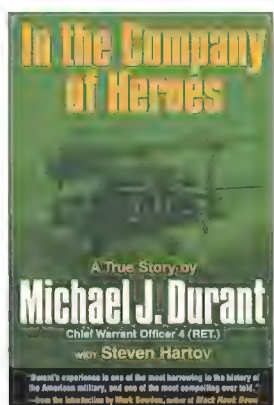
Ramo is at times a splendid and fascinating writer. He is omnivorously knowledgeable—and he never lets you forget it, whether he's holding forth on

haiku, Nietzsche, the paintings of Willem de Kooning, or post-doc risk-analysis monographs. And he's a pilot, though one still naive enough to boast, in the jacket copy, that he "holds two U.S. national point-to-point speed records." This doubtless gives non-pilot readers the impression that he has firewalled the throttle of an LAX-to-JFK Bearcat or Learjet, but those of us who have indulged in the "speed-record" sport know that the game is to

find an airport pair never before contested, pay the fee to have one's time affirmed, and thus get your name in an inconsequential record list. Ramo's records? "From Teterboro [airport, outside of New York City] to a small field in Pennsylvania and back in a Piper Arrow. I think the speed was 146 knots," he admits.

*No Visible Horizon* could have been one of those rare works written by a creative and talented individual who happens to also be a pilot. But Ramo tries too hard, so pleased with himself that he can't avoid overstating everything he experiences or imagines.

—Stephan Wilkinson has done just enough aerobatics to know that Joshua Cooper Ramo is if nothing else a better aerobatic pilot than he is.





## Project Orion: The True Story of the Atomic Spaceship

by George Dyson. Owl Books, 2003. 345 pp., \$16.

**P**roject Orion asks you to imagine a world where Apollo was consigned to history's trash can before it left the drawing board. It is the story of a team of accomplished nuclear scientists, including the author's father (and *Air & Space*/Smithsonian contributing editor), Freeman Dyson, who designed a spaceship powered by nuclear bombs. Starting in 1957, the team planned missions to Mars by 1965, and to Saturn by 1970, not in capsules but in 4,000-ton space cruisers, complete with a two-ton traditional barber's chair. It was a serious, if extravagantly imaginative and grand-scale plan for space exploration.

George Dyson describes the technical details elegantly: "To visualize Orion, imagine an enormous one-cylinder external combustion engine: a single piston reciprocating within the combustion chamber of empty space." He is equally good at capturing the buccaneering spirit of the project team at the General Atomics company. The book is full of appealing details like the description of trials of a C4 explosive-powered scale model at Point Loma on the California coast and discussions with the Coca-Cola company on shifting thousands of nuclear bombs, like bottles in a factory, so that one could be fired every half-second.

Particularly touching are his father's memories of the cafeteria and library at La Jolla—at 135 feet in diameter, the latter was the same size as the Orion design—"We always imagined the ship with a big recreation area in the nose, and windows looking out forward and sideways so we could see the rings of Saturn sweeping overhead as we passed through." Undeterred by the prospect of surfing nuclear explosions, the designers expected to become crew members.

The 1963 atmospheric test ban delivered the death blow to the already-moribund program, but it lives on in the minds of its designers: "It would have worked," says one. "Even in my dotage,

I'm a true believer." In 1965, the project won a short-lived reprieve as the model for the Discovery spacecraft in Stanley Kubrick's film *2001: A Space Odyssey*. It was a fitting end to a project that was almost science fiction.

*Project Orion's* narrative is sometimes lost among the fascinating details; tighter editing and a little weight loss would have enhanced it. The illustrations are few and disappointing. Nevertheless, it's a tantalizing story and a good read about one of history's great "what if" scenarios. While designers are still struggling with single-stage-to-orbit rockets, Orion would have gone "from downtown Jackass Flats to Saturn orbit back to low earth orbit in a single stage," according to writer and rocket designer Scott Lowther. Team member Ted Taylor may have captured the spirit of the project best: "The first flight of that thing... would be the most spectacular thing that

humans had ever seen."

—Matthew Stibbe is a business and aviation writer living in London.



## The Mercury 13: The Untold Story of Thirteen American Women and the Dream of Space Flight

by Martha Ackmann. Random House, 2003. 227 pp., \$24.95.

**M**artha Ackmann chronicles a shocking period in NASA history: In 1961, 13 women pilots passed the

same tests as the original Mercury 7 astronauts—in some cases exceeding the men's performances and qualifications—but were never seriously considered for early U.S. spaceflight missions. Despite



their daring, often record-setting accomplishments as pilots, the women were mocked as "girl astronauts" by Air Force Brigadier General Donald

Flickinger, and dismissed as "110 pounds of payload for recreational equipment" by a high-ranking NASA official. In truth, the lighter, smaller women would have improved fuel efficiency in those early flights, but, according to the author, "egregious" sexism in the military and at NASA prevailed.

In 1957, Jerrie Cobb, after posing in the requisite dress and high heels, set out to break the world record for high-altitude flight in a light aircraft. She succeeded, reaching 30,330 feet (she set the record again in 1960 at 37,010 feet); this achievement and others drew the attention of scientists who wanted to see if objective data would support the idea of women in space. Cobb and 12 other women passed the same rigorous tests—physical, mental, emotional—at the Lovelace Clinic that their more famous brethren did. Along the way, several of the women surpassed by hours the men's times in the infamous isolation tank, and some had thousands more hours of flying time than the men. No matter: Even after Congressional hearings, the highest powers declared that women were "not required" in space.

Not until 1983, more than 20 years after the Mercury 13 proved their mettle as potential astronauts, did an American woman, Sally Ride, visit space. It was 15 years longer before Eileen Collins commanded a U.S. spacecraft, *Columbia*, with most of the surviving Mercury 13 present at Cape Canaveral for liftoff.

Ackmann's prose does not soar like an eagle, and the many footnotes are distracting, but the steady accumulation of facts forms a damning picture of the times and creates a valuable addendum to the popular history of spaceflight.

—Nan Chase last reviewed *Secret Empire: Eisenhower, the CIA and the Hidden Story of America's Space Espionage for Air & Space*.

## The Pilots

by James Spencer. G.P. Putnam's Sons, 2003. 268 pp., \$23.95.

**W**ant to fly with young pilots amid the heat, sweat, noise, and terror of World War II air combat in the Southwest Pacific? Want to experience the pilots' escape from the cruelty of war as they consort in Australia with young women already torn by the pain of losing their husbands and brothers?

James Spencer's *The Pilots* is easy to read, difficult to put down, and almost



## The Universe: 365 Days

by Jerry Bonnell and Robert Nemiroff. Harry N. Abrams, 2003. 740 pp., \$29.95.

Since 1995, NASA's Astronomy Picture of the Day Web site (<http://antwrp.gsfc.nasa.gov/apod/astropix.html>) has offered breathtaking glimpses of the universe and man's attempts to explore it. Editors Jerry Bonnell and Robert Nemiroff have paired the site's most



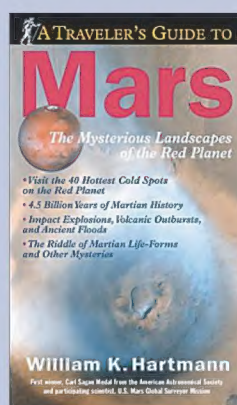
captivating images—the prismatic sky near Antares, a moonscape of Io, a lonely

portrait of Apollo 15's lunar module Falcon, and others—with good-humored captions. Would the Rosetta nebula by any other name smell as sweet? Perhaps, but the sun's solar-magnetic bananas certainly wouldn't be as tasty.

## A Traveler's Guide to Mars: The Mysterious Landscapes of the Red Planet

by William K. Hartmann. Workman, 2003. 468 pp., \$18.95.

In August, Mars' closest approach in 60,000 years will bring it within 35 million miles—a

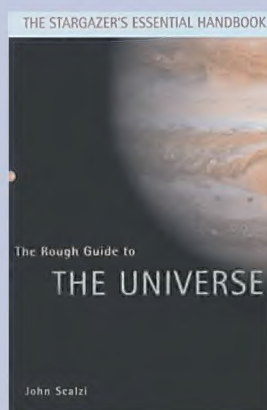


daytrip by galactic standards. Know a good place for lunch? Astro-geologist William Hartmann's dressed-up textbook fails to honor the inherent humor of its concept; there is little imagination and almost no helpful information for tourists. Stunning photography and insightful vignettes about the author's career reveal Mars for what it really is—a rock lover's paradise—but can't save droning copy which seems to leave no stone on the planet unturned.

## The Rough Guide to The Universe

by John Scalzi. Penguin Books, 2003. 390 pp., \$16.95.

During August, even novice astronomers can see Mercury, Venus, and Mars, spot four comets, and catch the Delta Aquarid and Perseid meteor showers—if they know when and where to look in the sky. Nearly 70 star charts depict well-known (Ursa Major, the 12 zodiac signs) and not-so-well-known (Ophiuchus, Serpens Caput) constellations, and explore the legends behind each. *Rough Guide's* real strength, however, lies in its breezy explanations of how telescopes work, the universe's beginnings, the Drake Equation (for estimating the number of alien civilizations), asteroids, wormholes, and other astronomical luminaries.



impossible to categorize; it is not a history, not a novel, and far more than a collection of short stories. The book's 15 interwoven tales, some of which previously appeared in literary journals like the *Ontario Review*, follow recurring characters from their aviation-obsessed



childhoods to aerial conflict over what should be paradise. Main characters Blake Hurlingame, a B-24 pilot with a tender concern for his crew, and P-38 Lightning pilot Steve Larkin, who downs 11 Japanese

warplanes and is shot down himself, grow up together but never meet in the combat zone. Here, in what should be paradise, the real enemy is not so much the Japanese as the danger that—for

moments at least—the pilots will grow to like war too much.

Spencer flew as copilot and later in the left seat of a B-24 Liberator above the ocean expanses and tropical forests his prose portrays so vividly. He came home with a Distinguished Flying Cross to undergo experiences unusual for a military man, including a career as a psychotherapist and a friendship with counterculture novelist Ken Kesey.

Spencer says he wrote a novel he couldn't sell, only to have an agent suggest that he make *The Pilots* a collection of related stories. That decision was a misstep. Spencer has a little of the poignancy and wit of *Catch 22's* Joseph Heller, the lean starkness of *The Hunters'* James Salter, and, ultimately, a voice all his own. He has given us a superb book. Had he chosen the bolder path, he could have given us the great novel about men who fly and fight.

—Robert F. Dorr is the author of *Air Force One*.

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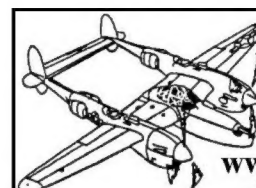
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Wright Brothers in Berlin, 1909



10,000th P-47 Delivery, 1944



Pan Am's First 707, 1958



SR-71A Blackbird, 1978

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## CREDITS

**Going Topless.** Colonel Joseph L. Vogel is a 30-year veteran of the U.S. Air Force and the Air National Guard. He is a lecturer in aviation history and physiology at Ohio State University, and describes himself as a recovering jet fighter pilot.

**When Cessnas Wore Rotors.** Walt Shiel is the author of *Cessna Warbirds: A Detailed and Personal History of Cessna's Involvement in the Armed Forces* ([www.CessnaWarbirds.com](http://www.CessnaWarbirds.com)).

**The Magical History Tour.** Mary Collins teaches writing at Johns Hopkins University.

**Growing Pains.** Robert Zimmerman writes extensively about space and science. His newest book, *Leaving Earth: Space Stations, Rival Superpowers, and the Quest for Interplanetary Travel*, has just been published by Joseph Henry Press.

**The Comet Affair.** Jeffrey A. Engel is an Olin Fellow of International Security Studies at Yale University.

**Astronaut, Cosmonaut... Euronaut?** Longtime contributor William Triplett last wrote for *Air*

& *Space/Smithsonian* about F-111s in the Royal Australian Air Force (Feb./Mar. 2002).

**How Things Work: Ground Proximity Warnings.** Damond Benningfield is a freelance science and technology writer in Austin, Texas. He produces the daily StarDate radio series and its Spanish counterpart, Universo.

**Vang's War.** Roger Warner is a journalist and historian living in Massachusetts.

**Restoration: Yellow 10.** Phoenix, Arizona pilot and writer Howard Stansfield last wrote about people who investigate aircraft crash sites as a hobby ("All That Remains," Oct./Nov. 2002).

**Last Stand at Kai Tak.** Roger A. Mola is an aviation writer based in Arlington, Virginia.

**The Rest of the Rocket Scientists.** Anatoly Zak is a freelance journalist who has been covering the Russian space program since the end of the 1980s. A native of Moscow, he worked as a space reporter for the independent daily newspaper, *Nezavisimaya Gazeta*.

## CALENDAR

### August 2

Korean Air War Special Event. Planes of Fame Museum, World War II Cal-Aero Field, Chino, CA, (909) 597-3722, [www.planesoffame.org](http://www.planesoffame.org).

### August 16 & 17

Chicago Air & Water Airshow. Chicago's Lake Front, Chicago, IL, (312) 744-3370.

### August 22–24

Sussex Airshow. Sussex, NJ, (973) 875-0783, [www.sussexairshowinc.com](http://www.sussexairshowinc.com).

### August 30–September 1

Cleveland National Air Show. Featuring the U.S. Navy Blue Angels and an Unlimited-class air race demonstration. Burke Lakefront Airport, Cleveland, OH, (216) 781-0747, [www.clevelandairshow.com](http://www.clevelandairshow.com).

### September 7

Pottstown Aircraft Owners and Pilots Fly-In Breakfast. Pottstown-Limerick Airport, PA, (610) 495-6366.

### September 12–14

Dawn Patrol Rendezvous World War I Fly-In. United States Air Force Museum, Wright-Patterson Air Force Base, OH, (937) 255-8046, ext. 312.

### September 13

Korean War Special Event and Unveiling of Restored Grumman F9F-5 Panther. Combat Air Museum, Forbes Field, Topeka, KS, (785) 862-3303.

### September 13 & 14

Antique Airplane Club of Greater New York Fly-In. Brookhaven Calabro Airport, NY, (631) 589-0374.

### September 19–21

Springfield Air Rendezvous Airshow. Capital Airport, Springfield, IL, (217) 789-4400, [www.springfield-il.com/airshow](http://www.springfield-il.com/airshow).

### September 27 & 28

Fina-CAF AIRSHO 2003. Commemorative Air Force, American Airpower Heritage Museum, Midland International Airport, TX, (915) 567-3009.

### December 12–17

First Flight Centennial Celebration. Wright Brothers National Memorial, Kill Devil Hills, NC. Tickets, which are \$10 per day, can be purchased online at [www.wrightbrothers.reserveworld.com](http://www.wrightbrothers.reserveworld.com) or by calling (800) 973-7327. Information about this event is available at the Web site [www.firstflightcentennial.org](http://www.firstflightcentennial.org).

*Organizations wishing to have events published in Calendar should fax press releases two months in advance to (202) 275-1886 or mail them to Calendar, Air & Space/Smithsonian, MRC 951, P.O. Box 37012, Washington, DC 20013-7012.*



## FORECAST

### In the Wings...

#### Fly Army!

How a West Point alum assembled the largest collection of U.S. Army aircraft in the world and marches them off to airshows each season.



SKY SOLDIERS MEDIA

A Hughes OH-6A "Loach" lands.

#### Giant Killer

After a long stretch in second place, Airbus just moved up.

#### One-Way Ticket From Space

Inflatable reentry vehicles: Reliable rescue craft or the next extreme sport?

#### To Spin or Not to Spin

In 1949, the Federal Aviation Administration stopped requiring private pilots to get training in recovering from spins. Today, pilots still argue over the wisdom of that decision.

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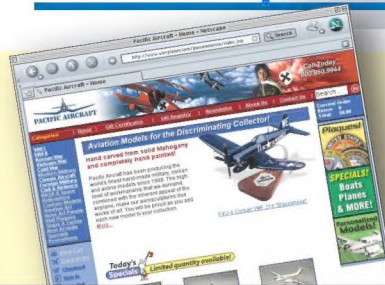
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# Gearing Up

In last issue's excerpts from *The Papers of Wilbur and Orville Wright, Volume One, 1899-1905* (McGraw-Hill, 2001), Orville summarized for sister Katharine their highly successful 1902 season at Kitty Hawk. In the following passages, Orville writes to fellow enthusiast George Spratt about big plans for 1903.

*Orville Wright to George A. Spratt, Dayton, June 7, 1903*

We are greatly increasing the size of the front rudder so as to have an abundance of control. About

13 horsepower on the brake, with a weight of only 150 lbs. in the motor. During the time the engine was building we were engaged in some very heated discussions on the principles of screw propellers. We had been unable to find anything of value in any of the works to which we had access, so that we worked out a theory of our own on the subject, and soon discovered, as we usually do, that all the propellers built heretofore are all wrong, and then built a pair of propellers 8-1/8 ft. in diameter, based on our theory, which are all right! ... Isn't it astonishing that

all these secrets have been preserved for so many years just so that we could discover them!! Well, our propellers are so different from any that have been used before that they will have to either be a good deal better, or a good deal worse.

P.S. Please do not mention the fact of our building a power machine to anybody. The newspapers would take great delight in following us in order to record our troubles.



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*The Flyer was assembled in this shed, a haven from the winds of Kill Devil Hills.*

Christmastime we began construction of the motor, which is of four cylinders, four-inch bore and four-inch stroke. We had estimated that we would require a little over eight horsepower to carry our weight of 625 lbs. of machine and man. Our motor on completion turned out to be a very pleasant surprise. Instead of the eight horsepower, for which we hoped but hardly expected, it has given us

*Wilbur Wright on "Experiments and Observations in Soaring Flight," Chicago, June 24*

There is no question in my mind that men can build wings having as little or less relative resistance than that of the best soaring birds. The bird's wings are undoubtedly very well designed indeed, but it is not any extraordinary efficiency that strikes with astonishment but rather the marvelous skill with which they are used. The soaring problem is apparently not so much one of better wings as of better operators.

*Moments & Milestones is produced in association with the National Aeronautic Association. Visit the NAA Web site at [www.naa-usa.org](http://www.naa-usa.org) or call (703) 527-0226.*

## LOGBOOK

### Awards

A U.S. Air Force unit, call sign "Grim 31," will receive the 2002 Mackay Trophy for rescuing 82 U.S. Army soldiers—including 28 injured—in Afghanistan during Operation Enduring Freedom. The soldiers had been trapped in a rugged valley by Taliban and Al-Qaeda forces.

On March 2, 2002, the 14-man crew of an AC-130 Spectre gunship engaged the enemy from overhead during a two-hour night operation that enabled two Black Hawk helicopters to land and pick up the battered troops. The Spectre team is part of the Air Force's 16th Special Operations Squadron, based at Hurlburt Field in Florida.

The Clarence Mackay Trophy, administered by the National Aeronautic Association and the U.S. Air Force, is presented annually for the most meritorious flight of the year and also for intrepidity, initiative, resourcefulness, and achievement of outstanding results in either combat or non-combat conditions. For the full story, visit NAA's Web site, [www.naa-usa.org](http://www.naa-usa.org), and click on "News."

### Events

NAA's annual Fall Awards Banquet will be held on November 10. Presentations include: National and World Record Flights, Katherine and Marjorie Stinson Award, Cliff Henderson Award, Elder Statesman of Aviation Award, and the Clarence Mackay Trophy.

### Centennial Certificates

To celebrate the centennial of powered flight, NAA is issuing a commemorative record certificate signed by a famous pilot: Scott Crossfield, Clay Lacy, Dick Rutan, Guy Townsend, or Chuck Yeager. The certificate is available only to those setting records during 2003, the 100th anniversary year. For information on setting aviation records, call NAA at (703) 527-0226 or e-mail [records@naa-usa.org](mailto:records@naa-usa.org).